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# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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# STELLAR ASSOCIATIONS*

By R. M. Petrie

During the last decade or so a new term has come into astronomical literature. It is "stellar associations". Some of you may have come across this and wondered about its meaning. It is proposed tonight to explain the use of the term "stellar associations" and to give some discussion of present knowledge of the nature and significance of these groups of stars.

When one examines a chart of stars plotted as they appear on the sky it is at once evident that a far from uniform distribution exists. If, further, we fix our attention principally upon the early types, (known as O and B stars) which include the very massive, hot, and highly luminous stars, the tendency toward clustering is much more pronounced. These stars are rarely found outside the Milky Way but even within this particular band they tend to occur in groups, scattered irregularly along the galactic circle. You are all familiar with the great cluster of such stars in the constellation of Orion, as distinguished from the relative scarcity of bright blue stars in neighbouring Taurus or Auriga.

The tendency of early-type stars to occur in groups was of course known to the early stellar cartographers. It was not at once clear, however, whether we were looking at actual concentrations of stars or whether the fluctuations in surface density merely reflected the statistical variation in selecting rare objects visib'e at very great distances from the sun. This question was fairly well settled by the Dutch astronomer Pannekoek in 1929 when, on the basis of the Henry Draper Catalogue and some knowledge of the intrinsic brightnesses of the stars, he estimated the distribution in space of stars of various spectral types. From Pannekoek's plots it is plain that the B stars do in fact occur in groups and clusters scattered generally close to the Milky Way. He was able to

*Presidential Address delivered at the At-Home of the Royal Astronomical Society of Canada, February 8, 1957.

distinguish, for example, condensations of luminous hot stars in Orion, in Carina, in Cygnus, Perseus, Scorpius, etc. In his paper, Pannekoek lists 37 such groups, or aggregations, of B-type stars. This work which, for some years, did not attract as much attention as it deserved, is really the foundation of the modern idea of the association of early-type stars into great groups in space.

It is not always easy to recognize associations in our own galaxy because the foreground stars confuse the situation and sometimes hide the relatively small numbers which form a physical group. These groups are more easily recognized when we look at external galaxies. The bright regions in the spiral arms of some of the nearest of the distant galaxies have been resolved by our largest telescopes and are found to contain very luminous hot stars and associated with them, clouds of gas and dust. We see these very plainly because the host of faint stars which confuses the view in our own galaxy is not seen in these very distant spirals, and the main structural features stand out rather boldly as a consequence.

The modern developments in studying stellar associations owe their inception to work by Joy on the T Tauri variables and by Bidelman on the great group of very luminous stars found in the region of the double cluster in Perseus. Beginning about 1947, the Soviet astronomer Ambarzumian, his colleagues and pupils, drew attention to the existence of stars apparently related in origin and development. There is a certain vagueness about what constitutes an association, but the following definition by Kourganoff may be adopted: "An association is a portion of a sub-system of stars of relatively uncommon type, such as OB supergiants or T Tauri variables. Any relative condensation with certain structural peculiarities may constitute an association." We note that associations are not star clusters. The latter represent a considerable local increase in space density and comprise different types of stars; while associations are collections of stars of the same general kind imbedded in the denser galactic population. Star clusters may be seen and photographed directly; associations are found by studying individual stars and selecting those of a certain kind inhabiting a relatively small volume of galactic space.

As described by the Soviet astronomers, associations possess certain properties. They have a roughly spherical form, with diameters of the order of one hundred parsecs, and contain nuclei of one or more galactic clusters. Diffuse gaseous nebulae usually lie within the confines of the association. The space density is high for the kind of star concerned but is lower than that for the galaxy generally. The number of members

is small, usually from 30 to 125, and the space density is about 1/1000 that of the general galactic field. Two kinds of associations have been distinguished; T associations containing T Tauri stars, associated emission-line stars and RW Aurigae variables; and O associations consisting essentially of O and B stars. In what follows only the O associations will be discussed since for them the information is more comprehensive and the picture is more clear.

The small number of stars in an association, together with the great volume of space which they occupy, has led to the conclusion that associations must be disintegrating and the individual stars must soon be dispersed into the general galactic population. It can be shown that the galactic tidal effect would disperse the members in a relatively short time, say about 10 million years. The fact that we see associations at all, and that they are roughly spherical in form, has led to the following deductions: (1) assocations are young and contain young stars, (2) associations are formed frequently, perhaps one every 100,000 years, (3) associations are expanding, the members separating from each other at an average rate of about 5 km. per second (see figure 1).

The above conclusions have given weight to the theory that stars are being born even now out of the material of interstellar space. In some way not yet understood the dust and gas clouds condense into stars and these stars, because of the relative motions of the original clouds or because of some explosive mechanism not specified, move away from each other and are seen by us as an expanding association. The more enthusiastic proponents of this theory even describe older and younger parts of the association, the more dispersed parts containing the older members. Thus, for example, the Trapezium stars in the Orion group represent very young stars born just yesterday, astronomically speaking. A further application of the theory allows us to estimate the ages of the stars upon the assumption that the expansion has continued at its present rate from the beginning. As we shall see, this leads to a remarkably short age for the high-temperature stars in associations.

One can readily appreciate the interest engendered by the publication of the ideas outlined above. On this continent a good deal of valuable work has been done in the last decade on the subject of associations. This work has concentrated upon finding associations and making accurate spectroscopic and photometric measurements on the individual stars. Proper-motion studies have been made in the United States and in Europe in an effort to detect and measure the expected expansion. This fundamental work is of the greatest importance as it is absolutely necessary to have the most accurate information if we are to exploit the

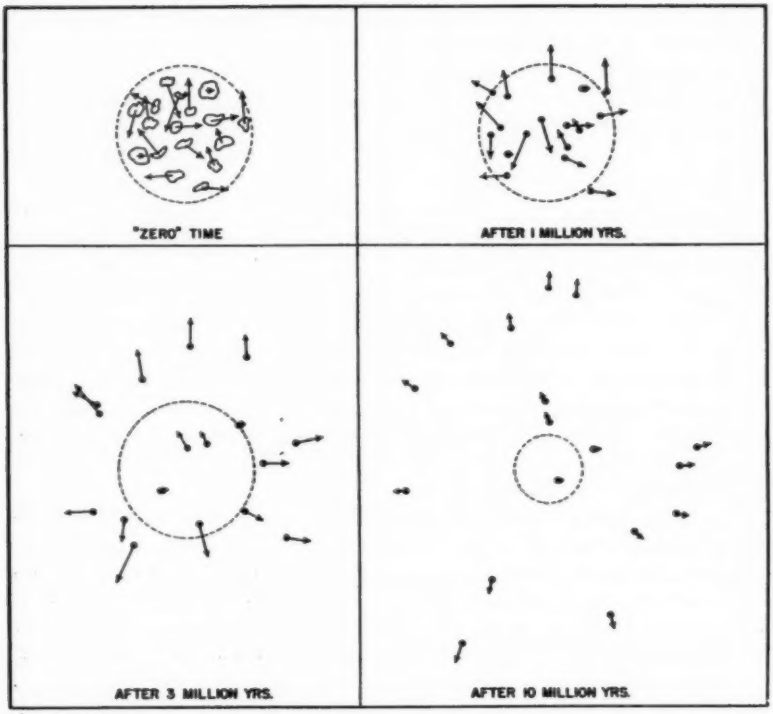


FIG. 1–Development of an expanding association. A number of clouds of interstellar matter endowed with random motions condensed into individual stars and, by virtue of the relative velocities, are seen to move away from their original place and become an expanding association after a few million years merely as a result of the original velocity distribution. (Diagrammatic)

theories and speculations which have been made and which, if substantiated, will have an important influence on many fields of astronomy and cosmogony.

Let us now turn to the observational results obtained about one or two associations. Perhaps the best known case is the $\zeta$ Persei group, a collection of about seventeen B stars occupying a region roughly 40 by 20 parsecs and 300 parsecs (about 1,000 light-years) distant from us. Figure 2 shows the relative proper motion vectors plotted for individual stars together with an indication of the associated nebulae, and figure 3 shows the proper motions in declination plotted against declination. In a detailed study of the $\zeta$ Persei association Blaauw has deduced a velocity

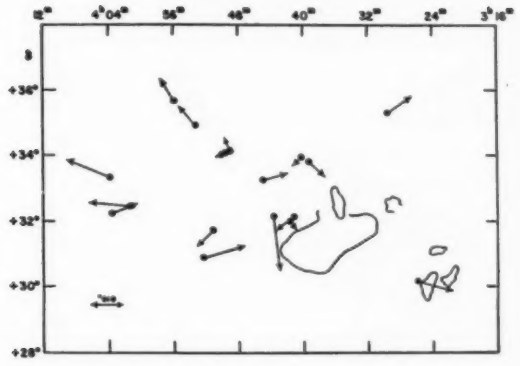


FIG. 2–Relative proper motions in the $\zeta$ Persei association. The stars of this association are shown in their relative position on the sky and the arrows give the relative observed angular motions. It is seen that there is a general tendency for the stars to move away from a common area, although there are some exceptions. The irregular marks indicate the positions of interstellar clouds.

of expansion of some 12 km./sec. and finds a very low age of 1,300,000 years for the group.

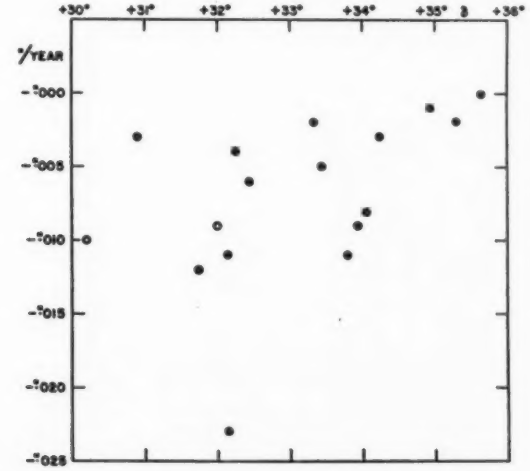


FIG. 3–Proper motions in declination for members of the $\zeta$ Persei association. The general tendency of the plotted points to follow an upward sloping line is evidence that the association is expanding.

Another group long known to astronomers as the Scorpio-Centaurus stream was studied in detail by Blaauw while he was working in Holland. He finds an expansion of about 1 km./sec. and concludes from the present shape of the group that it originated as a compact expanding association some 70 million years ago.

More recently Blaauw and Morgan at the Yerkes Observatory have described an association in Lacerta containing 29 early-type stars at a distance of about 450 parsecs from the sun. Proper motions indicate an age of about 4,000,000 years and suggest a velocity of expansion of 8 km./sec.

The number of associations now recognized is between 25 and 30. In an important paper published in 1953, the three American astronomers Morgan, Whitford and Code gave a list of 27 associations and obtained spectroscopic and photometric measures of the brightest members in each. They were then able to estimate the distances to the associations and, upon plotting their positions, found that they outlined the positions of possibly three of the spiral arms of our galaxy. This marked an important step in the study of the structure of our galaxy and emphasized the importance of associations in such studies.

Some years ago the astronomer Kourganoff pointed out that accurate radial-velocity measurements on association members would in the end prove or disprove the expansion hypothesis with all its implications. The proper-motion data are at best uncertain because the apparent motions of such distant stars are always very small. We can, however, obtain line-of-sight speeds with the necessary accuracy by means of the measurement of wave-length shifts upon spectrograms. Some radial-velocity data have been studied for one or two associations but in fact the material is not yet sufficiently precise and extensive for conclusive results. It is appropriate to mention this here because Canada is one of the leading countries in this kind of astronomical work. The large telescopes at Toronto and Victoria will make an important contribution through the measurement of line-of-sight speeds of members of associations.

Spectroscopic studies offer another important tool in the study of associations in that they will allow us to determine distances of individual stars by the method of spectroscopic parallaxes discussed here on this same occasion a year ago. We can, by applying this method, place the individual stars in correct positions relative to the centre of the association and so carry out a more satisfactory three-dimensional study of the aggregation and its internal motions. A combination of the two kinds of spectroscopic measurements should eventually settle conclusively the question of expansion of the members.

As an example of the proposed method we give results obtained at Victoria on the radial velocities of members of the double cluster in Perseus and the surrounding high-luminosity stars forming the association. Radial velocities and distances are given for individual stars in Table I. These are preliminary results given here for the first time and are to be strengthened by additional observations.

TABLE I

DISTANCES AND RADIAL VELOCITIES OF PERSEUS STARS

| Star | Type | m | $M_v$ | r parsecs | Vel. km./sec. |
|---|---|---|---|---|---|
| | | Outer Stars | | | |
| H.D. 12856 | B0e | 8.55 | −5.1 | 2700 | −32.4 |
| H.D. 13051 | B1 | 8.72 | −3.8 | 1840 | −48.1 |
| H.D. 13267 | B5 | 6.39 | −5.7 | 1410 | −33.8 |
| H.D. 13402 | B0.5 | 8.06 | −6.2 | 2200 | −49.6 |
| H.D. 13831 | B0 | 8.27 | −5.5 | 3260 | −35.5 |
| H.D. 13866 | B2 | 7.52 | −5.5 | 2400 | −41.8 |
| O. 49 | B1 | 9.08 | −4.8 | 2850 | −21.0 |
| H.D. 13900 | B1 | 9.19 | −3.3 | 2000 | −61.8 |
| O. 2246 | B2 | 9.90 | −2.9 | 1710 | −58.8 |
| H.D. 14818 | B2 | 6.25 | −5.9 | 1450 | −49.8 |
| H.D. 14956 | B2 | 7.22 | −6.4 | 1580 | −29.4 |
| H.D. 15497 | B6 | 7.03 | −6.2 | 1280 | −36.9 |
| H.D. 15642 | B0 | 8.54 | −5.2 | 3300 | −49.2 |
| H.D. 15690 | B1.5 | 8.00 | −5.4 | 1280 | −46.8 |
| | | Inner Stars | | | |
| H.D. 13841 | B2 | 7.40 | −5.3 | 1890 | −35.8 |
| H.D. 13854 | B1 | 6.49 | −6.3 | 1780 | −42.7 |
| H.D. 14134 | B3 | 6.55 | −6.6 | 1800 | −40.6 |
| H.D. 14143 | B2 | 6.66 | −7.2 | 2440 | −42.6 |
| O. 1187 | B2 | 10.82 | −2.6 | 2040 | −31.7 |
| H.D. 14357 | B2 | 8.53 | −4.2 | 1660 | −45.1 |
| H.D. 14443 | B2 | 8.05 | −4.5 | 1520 | −38.2 |
| O. 2139 | B2 | 11.35 | −1.5 | 1860 | −40.2 |
| O. 2185 | B2 | 11.01 | −1.0 | 1160 | −39.9 |
| O. 2232 | B2 | 11.05 | −1.4 | 1550 | −33.6 |
| O. 2296 | B4 | 8.53 | −4.2 | 1850 | −43.0 |
| H.D. 14520 | B2 | 9.15 | −3.4 | 1510 | −51.2 |
| H.D. 14542 | B6 | 7.00 | −5.8 | 1330 | −46.4 |

The inner stars, which are those in the double cluster itself, are at the same distance on the average as those in the more widely scattered outside regions forming the association. The average distance is found to be 1800 parsecs, or 5900 light-years, from the sun. The spectroscopic distances indicate a close clustering for the inner stars and show that the outer members are widely scattered throughout a considerable volume of space. The distance distributions shown in Table II demonstrate this rather well.

TABLE II

DISTANCE DISTRIBUTION OF PERSEUS STARS

| Distance Limits | Inner Stars | Outer Stars |
|---|---|---|
| parsecs | | |
| 500–1000 | 00% | 6% |
| 1000–1500 | 23 | 23 |
| 1500–2000 | 62 | 23 |
| 2000–2500 | 15 | 18 |
| 2500–3000 | 00 | 18 |
| 3000–3500 | 00 | 12 |

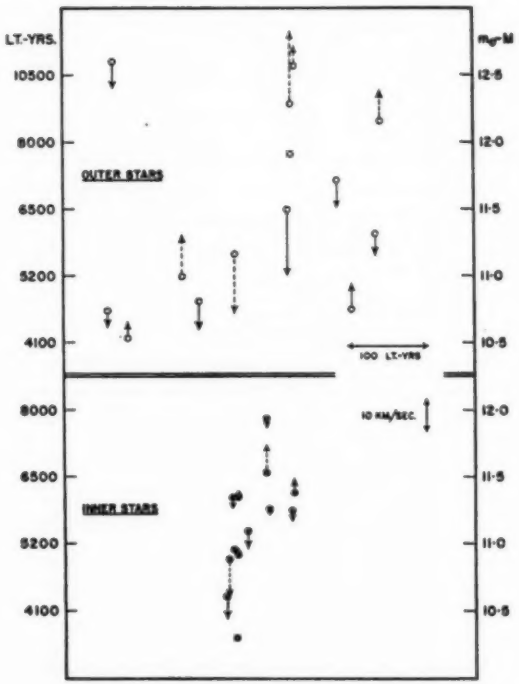


FIG. 4–Distances and line-of-sight speeds for members of the Perseus double cluster association. In the diagram distance from the sun is plotted vertically and east–west position in the sky is plotted horizontally. The attached arrows give the amount and direction of the speed in the line of sight. The outer stars are seen to occupy an enormous volume of space, while the inner stars form a more compact group. There is a good deal more scatter in the line-of-sight motions of the outer stars. The motions as observed do not confirm the assumption that the group is expanding.

The radial velocities average about 40 km./sec. of approach, which is almost entirely accounted for by the differential velocity of galactic rotation between the regions of the sun and the cluster. The scatter in the observed velocities indicates that the stars of the inner group have closely a common motion. On the other hand, there is evidence that the outer stars exhibit a definite range in velocity between the individual members. A two-dimensional plot of the positions of the stars is given in figure 4, where distances are plotted in the vertical direction and the east-west direction is horizontal. Attached to each point is an arrow giving the direction and amount of the line-of-sight speed. One must conclude from these data that the association does not exhibit a general expansion of its members. Observations of the Perseus group, and one or two other associations, now going forward at Victoria will provide reliable data with which the expansion idea may be rather thoroughly checked.

The purpose of the present address is to give a general account of the subject of stellar associations but not to engage in a critical discussion of this novel and important idea with its wide appeal to students of galactic structure and stellar evolution. Nevertheless, we may permit ourselves a certain degree of caution over accepting the several deductions made on the rather preliminary studies of associations until they are more fully confirmed by observational material. We have seen how the proper motions appear to verify expansion in the $\zeta$ Persei and Lacerta associations, while the radial velocities appear to disprove radial expansion in the case of the double cluster group. There are difficulties also in understanding how the motions of expansion could arise in a relatively small volume of interstellar material and permit the escape of stars from a relatively compact mass. One would like to see some discussion of the role of the numerous ordinary galactic stars which lie within the association and must tend to prevent dispersal of its members.

The association idea has been most valuable in stimulating research and suggesting new avenues for studying the structure of the galaxy. Even if we have to modify the original idea in some of its cosmogonical aspects, it has made an important contribution in emphasizing the irregular nature of the outer parts of our Milky Way and the significance of the far-from-random distribution of the stars of high temperature and great luminosity.

Dominion Astrophysical Observatory,
Victoria, B.C.,
January 25, 1957.

# A VISUAL AURORAL PROGRAMME FOR THE I.G.Y.

By Peter M. Millman

During the International Geophysical Year, in which scientific teams from over 50 nations are co-operating, one of the most significant of Canadian programmes will be the observation of the aurora and associated phenomena of the upper atmosphere of the earth. Canada has a unique geographical position for the prosecution of this type of investigation. The north magnetic pole is situated in our northern territories and the geo-magnetic pole is just off the coast of one of our northern islands. As a result the aurora can be observed as easily in Canada as in any country of the world, and it is a fairly common sight even along our southern border.

The Canadian Government, in co-operation with a number of universities, has planned an extensive programme of instrumental observation of the aurora, the earth's magnetic field, and the ionosphere. Data will be recorded throughout the 20 months of the I.G.Y. over a network of stations ranging from latitudes 43° to 83° N. These will be collected at various headquarters in Ottawa for distribution to all the co-operating nations.

Visual auroral observations will play an important role in supplementing the instrumental data, since visual observers cover a much larger area than the instrumental net. One of the features of the aurora, which has been little studied to date and which we are emphasizing in our programme, is the synoptic distribution of the auroral features over the North American Continent. It is hoped to plot maps, similar to the synoptic weather maps, showing the location of the aurora at each hour of the night.

The Canadian visual programme has been planned in consultation with Professor B. W. Currie, of the University of Saskatchewan, and Professor C. W. Gartlein, of Cornell University. A uniform system of reporting will be used over all of North America. The international classification of standard auroral forms has been modified to reduce the number of types to a minimum in order to simplify the reporting procedures as much as possible. These forms are illustrated by representative sketches in figure 1, together with the standard abbreviations to be used. The important distinction between homogeneous and rayed forms has been retained, but where a difference in the appearance results chiefly from the differences of relative position of observer and auroral feature one classification is used for all variations. For example, the older terms —drapery, corona, and rayed band—have been included under rayed arcs.

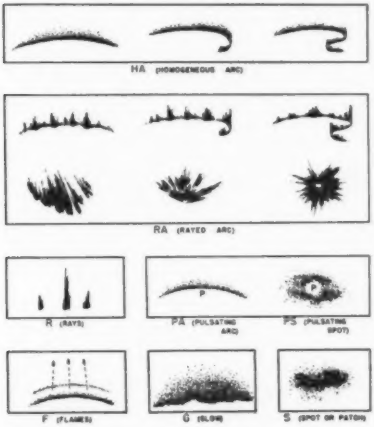


FIG. 1–Standard auroral forms and abbreviations for I.G.Y. Visual Programme.

A simple report form has been designed and is illustrated in figure 2. The presence of aurora may be indicated on this by small sketches, by abbreviations, or where the observer does not classify the feature, by the word "aurora". The data from these forms will be transferred to I.B.M. punched cards at headquarters and, wherever possible, machine methods of handling the statistical material will be used. There will be close co-ordination between the U.S. headquarters at Ithaca and the Canadian headquarters at Ottawa.

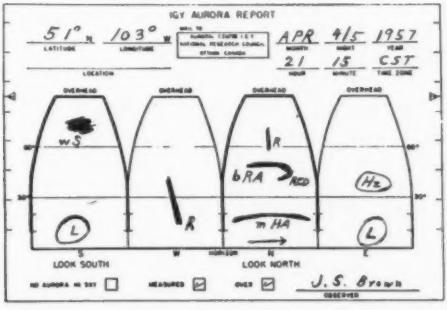


FIG. 2–Front face of the visual auroral report form.

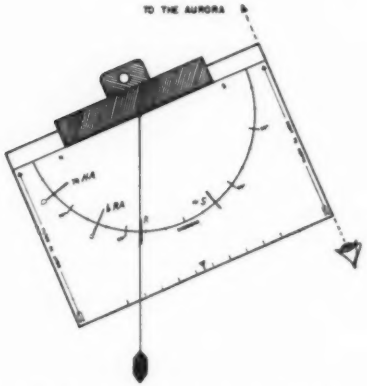


FIG. 3–Method of using the back face of the report form for making measurements of the elevation of auroral features.

The back of the report form, illustrated in figure 3, may be used to make measurements of the elevation of auroral features. This part of the programme is for those observers who are able to devote a little more time to an observation.

Three groups of visual observers will be of particular importance in this programme, and it is hoped that all three will be able to co-operate actively. The meteorological stations, because of their widespread network, will give the greatest extent of coverage; the airline pilots, because of scheduled flights above cloud, will be a vital factor in filling bad weather gaps in our synoptic picture; and the Centres of the Royal Astronomical Society of Canada and other similar groups, because of their ability to plan a full-time programme of night observation, will be able to report in considerable detail the progress and development of the auroral displays.

Pads of report forms and detailed instructions are now available for distribution to all points in Canada. If you wish to be associated with this programme write to "Auroral Centre, I.G.Y., National Research Council, Ottawa". Observers in the United States should communicate with Dr. C. W. Gartlein, Cornell University, Ithaca, N.Y.

Although the aurora has been studied for many years, there are still important basic unsolved problems concerning its physical properties, geographical distribution, and morphology. The International Geophysical Year offers an excellent opportunity for making a concerted and widespread scientific attack on these problems.

## CANADIAN SCIENTISTS REPORT

# THE SCHMIDT TELESCOPE AND ITS APPLICATIONS

By William Wehlau*

One of the most difficult problems in optics is that of producing an optical system that is both fast and will give good definition over a large field for light of all colors. Lens systems require many individual components to control chromatic and other aberrations that result in images of poor quality. These complicated systems are generally impractical for large instruments. The cost of construction and absorption of light by the glass generally restrict them to small cameras. Parabolic reflectors are free from chromatic aberration and produce perfect images on the optical axis. However, the images rapidly deteriorate off the axis so that only a small field can be photographed satisfactorily in each exposure. Although many ingenious designs for both refracting and reflecting telescopes have been developed to provide a fast wide angle telescope, significant restrictions on the performance or construction have always remained.

For many applications this problem was solved in 1930 when Bernhard Schmidt produced one of the most important developments in optics by combining a lens and a mirror in one system. The Schmidt telescope employs a thin lens and a spherical mirror as shown in figure 1. The

Fig. 1–Schematic diagram of the optics of a Schmidt telescope fitted with an objective prism. The prism is to the left of the correcting plate; the location of a photographic plate between the correcting plate and mirror is also shown.

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mirror alone would be free from chromatic aberration but would produce poor images because of spherical aberration. The lens, or correcting plate as it is more commonly called, serves to deviate the incoming rays slightly before they reach the mirror so as to eliminate the spherical aberration of the mirror. Since the correcting plate has very little curvature the amount of chromatic aberration introduced is generally negligible. Only when extreme speed or very wide angles are required does this become an important problem.

Although the Schmidt telescope has solved, to a high degree, the problem of producing a fast wide angle camera some disadvantages remain. The telescope tube must be twice the focal length of the instrument since the correcting plate is located at the center of curvature of the mirror. Although this is an important consideration because of the cost of the mounting and of the dome, it is mitigated by the fact that Schmidt telescopes are fast so that the length of the tube is not disproportionate with the aperture of the instrument. To avoid vignetting, the loss of light for off axis images in the optical system, the diameter of the mirror must be greater than that of the correcting plate. The larger the field of the telescope, the larger the mirror must be to collect all the light that enters the telescope. This disadvantage is partially offset by the fact that the mirror is spherical rather than parabolic. The location of the focal plane in the center of the telescope tube makes loading and unloading plates inconvenient. While some modifications of the Schmidt system do not have this disadvantage, for the most part it has been accepted and the loading of plates simplified by making it mechanically as simple and safe as possible. One of the most serious problems is that the focal surface is spherical instead of flat. Since the cone of light converging to form a star image is very steep for fast Schmidt telescopes a small error in the position of the photographic emulsion will produce out of focus images instead of the point images desired. To avoid this the emulsion must be deformed to agree accurately with the spherical focal surface. Since the radius of curvature of the focal surface is equal to the focal length of the instrument this becomes a serious problem for short focal length instruments. Then only film can be used since plates would break. A simple plano-convex lens can be placed in front of the focal plane to serve as a field flattener if the curvature is not too great.

The correcting plate usually has one surface flat and the other a fourth degree curve as shown, greatly exaggerated, in figure 1. This type of surface is difficult for the optician to make and adds considerably to the task of making a Schmidt telescope. The shape of the correcting

plate depends on the exact location of the focal surface; the most common form is shown. The images produced by this optical system are not theoretically perfect. Various aberrations remain, but for reasonable speeds and angles they are so small as to be negligible compared with the effects of seeing and the resolution of the emulsion (Brown, 1956).

Since the introduction of the Schmidt telescope many mirror-lens combinations, so called catadioptric systems, have been developed (Brown, 1956; Dimitroff and Baker, 1945). These have sought to remove or reduce the various problems connected with the Schmidt telescope or to reduce the remaining aberrations when they are significant for a special application. However, the original form of the Schmidt remains popular. It has been adapted to a large number of uses, especially as a camera for spectrographs both astronomical and laboratory. In astronomy it has come into use for a large number of problems including meteor photography and studies of the night sky and aurorae.

The larger Schmidt telescopes for the study of stars, nebulae and other astronomical objects have fields of about 10 degrees in diameter. Since the exposure times are ultimately limited by fogging of the plate by the light of the sky most of these telescopes have f numbers greater than 2. Faster telescopes than these would be limited to quite short exposure times and could not be used to their full advantage.

The principal uses of the Schmidt telescopes have been photographic as has been suggested in the discussion of its optical properties. Visual or photoelectric observations are possible by using a diagonal mirror to reflect the light coming from the primary mirror out the side of the tube. While observations are frequently made in this fashion, they do not take advantage of the special properties of the Schmidt telescope and could generally be performed more simply by other telescopes, ordinary reflectors or refractors. The combination of a wide field with short exposures allowed by the speed makes the telescope ideal for searching the sky for special objects or for statistical studies of various types of stars where large amounts of data must be collected in reasonable intervals of time.

Direct photography was the first application of the original Schmidt and has remained important. The most impressive application has been the use of the 48 inch Schmidt telescope at Mount Palomar in producing the National Geographic Society–Palomar Observatory Sky Survey (Bowen, 1956). This programme which required seven years to complete reproduces the sky as seen from Mount Palomar on 1758 plates, half in the blue and half in the red. It reaches a limiting magnitude of 21.1 in the blue and 20.0 in the red which includes a volume of space 25 times

greater than has been surveyed in other atlases. These reproductions provide an opportunity for identifying nebulae, clusters and other astronomical objects of all kinds that will require further study with other telescopes as well as forming a standard reference for the distribution of the stars.

Direct photographs also provide the opportunity of determining the magnitudes of large numbers of stars in the same region of the sky. Magnitudes and colors can be determined for clusters, variable stars and many other objects. Great care must be used to avoid systematic errors in the magnitudes derived from the star images on photographic plates taken with Schmidt telescopes. Many of the telescopes do not have mirrors large enough to avoid the loss of light for stars near the edge of the field so that vignetting occurs. This effect can be readily computed from the dimensions of the telescope and the error can be avoided by not using stars near the edges of the plates where vignetting occurs. The second source of error is more of a problem since it is liable to affect the whole plate and to differ for various plates. In bending the plate (or film) to match the spherical focal surface the plate has a tendency to buckle so that the ideal spherical surface is not produced. Where this buckling has occurred the images will be slightly out of focus. These images will give a different result when measured to determine magnitudes than if they had been in focus even when no apparent difference can be seen by visual inspection. This effect which varies over the plate can be determined by making several exposures on the same plate so that the same star appears at several places on the plate. Since it must have the same brightness regardless of where the image falls, the error can be determined and eliminated.

By placing a prism in front of the correcting plate, spectra of the stars are produced on the plate instead of the point images of direct photography. This has proved to be one of the most important uses of the Schmidt telescope and most of them are provided with one or more objective prisms. In this application the whole telescope is used as a camera to photograph the spectra which are produced by the prism. The plate then shows the spectra as narrow lines crossed by absorption lines. To show the absorption lines more clearly the spectra are frequently widened by moving the telescope perpendicular to the dispersion during the exposure.

A typical example of an objective prism spectrogram taken in this manner on a blue sensitive plate is shown in figure 2. The absorption lines which differ from spectrum to spectrum are characteristic of the physical and chemical properties of the stars and make it possible to

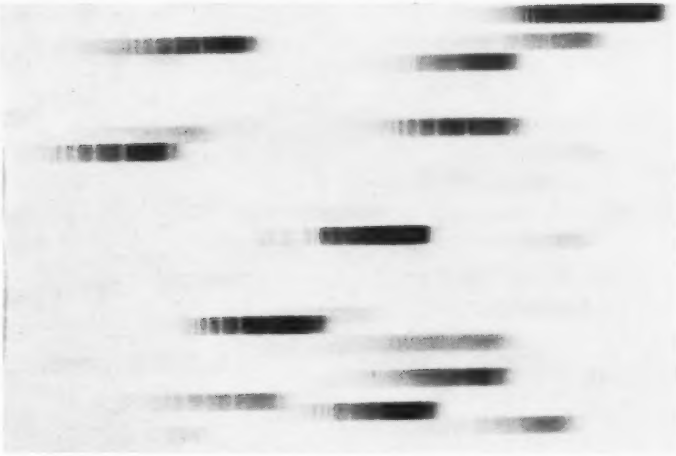

FIG. 2–Objective prism spectra in the blue. This is an enlargement of a section of a plate taken with a 24–36 inch Schmidt telescope. A four-degree objective prism was used which gave a dispersion of about 230 A./mm. on the original. Photograph courtesy of the Warner and Swasey Observatory.

divide the stars into the various spectral groups according to the appearance of the spectra. For example, the regular sequence of lines that is seen for several of spectra is produced by hydrogen and indicates a star of spectral class A. One of the spectra shows an emission line (which appears as a narrow dark line since this is a reproduction of a negative). The effect of seeing, vibrations of the telescope, etc. blur the spectra and make classification difficult. This makes objective prism spectra less sharp than those produced by the ordinary slit spectrograph used with a reflector or refractor. However the objective prism method has the advantage that each exposure will produce spectra of hundreds of stars while the slit spectrograph produces one spectrum. Thus the Schmidt telescope fitted with an objective prism can be used for the study of the distribution of the various types of stars or for the detection of stars of special interest for more detailed study with other instruments. Objective prism studies of this type with blue sensitive plates are particularly efficient in locating the highly luminous early type stars which radiate strongly in the blue light to which the plates are sensitive. In this manner the early type stars have been identified which outline the spiral arms of our galaxy and provide important information on the rotation of the galaxy.

If photographic emulsions sensitive to colors other than the blue are used with appropriate filters other regions of the spectrum may be studied. The infrared has proved to be particularly effective in this manner (Nassau and von Albada, 1949). Much lower dispersions are used for these spectra so that individual spectral lines cannot be seen but molecular bands which absorb strongly over a wide range in wavelength in this region of the spectrum appear as lines. Because of the lower dispersion of the prisms in the infrared, the same prisms that are used for the blue region of the spectrum can be used in the infrared. Figure 3 shows a section of a typical infrared objective prism plate.

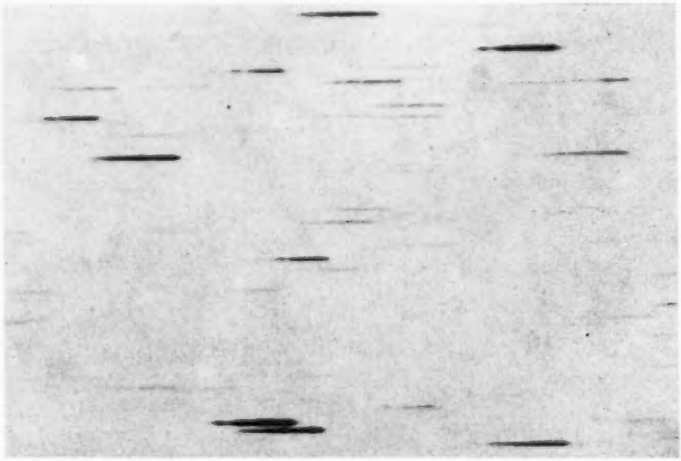

FIG. 3–Objective prism spectra in the infra-red. This is an enlargement of a section of a plate taken with the same instrument used for figure 2. A two and a four degree objective prism were used together which gave a dispersion of about 1100 A./mm. on the original. Photograph courtesy of the Warner and Swasey Observatory.

These spectra are unwidened. The line crossing each spectrum near the middle is due to oxygen in the atmosphere of the earth. The two strong spectra at the bottom of the plate are an M star, above, and a carbon star, below. The infrared is especially effective in locating these very red stars which radiate strongly in the infrared, and have strong absorption features in their spectra due to the molecules present in their atmospheres. Studies of M stars carried out in this manner have shown they are distributed in a fairly uniform manner in our galaxy and do not outline the spiral arms as the early type stars do.

Even lower dispersion objective prism spectra have recently been shown to be useful at the Yerkes Observatory (Morgan, Meinel and Johnson, 1954). These spectra with dispersions of about 20,000 A./mm. do not show the individual absorption features in the spectrum of the star but give only the overall outline of the spectrum which makes it possible to place a star in one of several broad classes. Of special interest here is the possibility of identifying very distant early type stars that are reddened by interstellar dust. The low dispersion used makes it possible to obtain and use spectra of much fainter stars than with the higher dispersions mentioned earlier.

In Canada the Schmidt telescope has found a number of astronomical applications, e.g. meteor photography with the Baker Super-Schmidt, photography of aurorae and as a spectrograph camera. In addition to these instruments with special applications the Schmidt telescope of the Hume Cronyn Memorial Observatory may be mentioned as a typical classical Schmidt telescope. This instrument has an eight-inch correcting plate, a twelve-inch mirror and a focal length of twenty-two inches which give an f-ratio of 2.7. Such an instrument is well suited for photographic photometry of stars and other astronomical objects and, if fitted with a prism, for low dispersion objective prism work. Observational programmes for this instrument are now being planned.

Only a few of the applications of the Schmidt telescope have been discussed. The ingenuity of the designer in modifying the Schmidt telescope for special purposes and of the observer in finding new ways of applying it will undoubtedly continue to increase its usefulness.

Hume Cronyn Memorial Observatory,
London, Ontario.

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## MINUTES OF THE ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The 67th Annual Meeting and At-Home was held at 8.15 p.m. on Friday, February 8, 1957, in the McLennan Physics Laboratory, University of Toronto; the President, Dr. R. M. Petrie, in the chair. Minutes of the Annual Meeting of January 18, 1956, were adopted as printed in the JOURNAL.

Owing to the absence because of illness of Mr. E. J. A. Kennedy, the report of the National Secretary was presented by Mr. J. H. Horning, National Treasurer. The report mentioned the purchase of the new National Headquarters building; modernization of the Society's office equipment and records; the deaths of several prominent and active members; appointment of Miss Ruth J. Northcott as Editor to succeed the late Dr. C. A. Chant; and the award of the Society's Gold Medal to Mr. Donald C. Morton.

Members stood for a minute in silent tribute to the "departed colleagues".

The meeting directed that the Recorder send a letter to Mr. Kennedy expressing the Society's best wishes for rapid recovery from his illness.

Dr. Petrie expressed pleasure at seeing an unusually large number of members present from Centres outside Toronto, the Centres at Quebec, Montreal, Ottawa, Hamilton, London and Victoria being represented.

Dr. C. S. Beals, the Dominion Astronomer and a past president of the Society, presented the Chant Medal to M. Maurice Drolet of the Quebec Centre. Reading the citation in both French and English, Dr. Beals noted Mr. Drolet's activities in organizing an expedition to Ungava to observe the 1954 total solar eclipse, and his efforts to popularize astronomy on French-language radio and television programmes. In his reply M. Drolet said he felt the award was not made to himself alone but in recognition of the work of all the amateurs in the Quebec Centre. He mentioned the observatory project now under way there, and expressed a hope the international meeting of astronomers might meet at Quebec in 1963 when a solar eclipse will be visible in the area.

Mr. Horning then presented his report as National Treasurer, and in moving its adoption he coupled a vote of thanks to Mr. M. A. Altman for his services as Auditor.

Dr. J. B. Oke, the Librarian, reported much greater use of the Library since the move into the new rooms. He said 44 periodical publications are being received, mostly in exchange for the Society's JOURNAL.

Miss Northcott, the Editor, reported increased advertising revenues

in the Society's JOURNAL and OBSERVER'S HANDBOOK, and noted also the change in cover designs.

Mrs. K. M. Heaton reported for the Board of Trustees, and Dr. J. F. Heard for the Property Committee on the purchase, renovation and operations of the new property. Dr. Heard noted that many generous donations from members had permitted reduction of the mortgage debt to $13,000, as well as a donation of $500 from the Toronto Centre to provide furnishings for the Library and Reading Room. He drew attention to the well-organized campaign by which the Victoria Centre collected almost a thousand dollars for the Building Fund. He hoped there would still be many donations to the Building Fund to reduce the mortgage still further. Dr. Petrie expressed his thanks to the many members who had helped in acquiring and fitting out the new Headquarters, and stressed expecially the services rendered by Dr. Heard.

In recognition of their services in connection with the new National office, the Annual Meeting voted unanimously to confer Life Membership on Mr. Carl Reinhardt and Mr. T. C. Newman, Q.C.

The Scrutineers, Mr. Reinhardt and Mrs. Heaton, reported that the ballots returned were almost unanimously in favour of the election of the Officers and Council recommended by the Nominating Committee; also that nearly all ballots were in favour of the recommended amendments to the Constitution and By-Laws. Only 27 members opposed the recommended increase in the annual dues to $5.00.

The President then declared the Officers and Council for 1957 duly elected as listed on the ballot, and called upon the new President, Dr. Helen S. Hogg, to take the chair.

Before calling upon Dr. Petrie for his Presidential Address, Dr. Hogg mentioned that two "milestones" in the Society's affairs had been reached under his presidency—the acquiring of the Society's first Headquarters of our own, and the inauguration of the "Canadian Scientists Report" series in the JOURNAL.

Dr. Petrie then delivered his address, "Association of Stars", which is printed elsewhere in this JOURNAL.

At the conclusion of the Presidential Address, the members and guests adjourned to an adjoining room for the Annual At-Home and to enjoy the refreshments provided by the Toronto Centre.

FREDERIC L. TROYER, *Recorder.*

## REPORT OF THE NATIONAL SECRETARY

The members of the Royal Astronomical Society of Canada should consider 1956 a landmark year in its history. During this year, the 67th of its existence, the Society has finally acquired a home of its own. This was a happy event of great importance to the Society. Not so happy was the loss through death of a number of senior members and leaders of the Society.

Amendments to the Constitution have been undertaken in 1956, and if passed will result in strengthening the Society.

A committee appointed by the National Council in late 1955, found and purchased 252 College Street—a really satisfactory building for the Society's national office. This house has four ground floor rooms used by the Society for offices, library, and reading room. A small apartment at the rear is occupied rent-free by a janitor in exchange for janitoring services. Three apartments on the second and third floors and a two-car garage are rented for a total of $230 a month. Special funds of the Society provided $12,500 cash payment on the purchase price of $32,500. A mortgage of $20,000 was assumed. Already this mortgage has been reduced to $13,000 as a result of 254 building fund donations; almost $1000 was collected by the Victoria Centre in a city-wide campaign. A special $500 donation was given by the Toronto Centre to supply tables, chairs, etc. for the library and reading room. The telescope makers group has made a workshop in the basement and provided an independent, outside entrance to it.

The Society is greatly indebted to a senior member of the Society, Mr. Carl Reinhardt. This gentleman retired to Toronto about a year ago, after a lifetime spent as a mining geologist at Cobalt. His generous donation of $2,000 to the building fund was preceded and followed by donations to the Library. A renter of one of the apartments, he has acted as chairman of the building committee. As such, he has rendered great service, supervising the many alterations, repairs, and decoration required to put the Society's property in excellent condition.

The following are some of the Society's members lost through death; Dr. C. A. Chant, Life Member of Toronto Centre, Dr. Ralph DeLury, Life Member of Ottawa Centre, Mr. T. H. Mason, Life Member of Toronto Centre, Capt. C. A. MacDonald, past President of Vancouver Centre, Mr. E. E. O'Connor, past President of London Centre, Mr. Frank Publow, second Vice-President of Toronto Centre, Dr. Tomingas, a councillor of Toronto Centre. Our sympathy is extended to the families of these men who served the Society well and long.

The Society lost in Dr. Chant, its oldest and most beloved member. He joined the Society, then known as the Astronomical and Physical Society of Toronto, on December 13, 1892. The Society was then two years old and listed 88 members, all but eight living in Toronto. While President of the Society (1904 to 1907) Dr. Chant edited and produced in 1906 the first volume of THE JOURNAL of the Royal Astronomical Society of Canada. He remained its editor until his death on November 18, 1956. His final contribution was for the September–October JOURNAL, a short biographical article on "Walter Sydney Adams". From 88 members and one centre in 1892, he helped to build the Society to its present 2400 members in 13 centres from Halifax to Victoria. A donation, during 1956, of $1000 to the building fund was evidence of his continued interest in the Society he helped to create.

Dr. Ralph DeLury, a professional astronomer at the Dominion Observatory, was a strong supporter of the Ottawa Centre. He also contributed $1000 to the building fund.

The Society grew during 1956 to a membership of approximately 2400. Most centres have shown an increase in membership. The members unattached to centres now number 605. The excellence of the OBSERVER'S HANDBOOK and the JOURNAL has made these publications popular and has brought in many unattached members from the U.S.A. The National Council has appointed Miss Ruth Northcott as Editor, a worthy successor to Dr. Chant. The Society owes her its thanks for the excellent work she has been doing as Assistant Editor.

During 1956 the National Council undertook to prepare amendments to the Society's Constitution. The members have had the proposed amendments mailed to them to be voted upon. When approved, the amendments will make easier the operations of the Centres and of the National office. The raising of the annual fee to $5.00 is necessary owing to the decreased purchasing value of the dollar. The fee increase will come into effect in 1958. It will not help in 1957. Donations will be appreciated still by the National Council.

The National office equipment and records are gradually being modernized. Our auditor, Mr. Morris Altman has kindly helped in this matter. His valuable advice and assistance is appreciated.

The vitality of the Society is revealed by communications received from various Centres. Montreal with its various Observation Groups and Monthly Letter, Victoria with its Summer Course, Toronto with its Summer Activities connected with the Canadian National Exhibition, give examples. Our youngest Centre, Halifax, is a sturdy addition to our family.

The Society continues to encourage students of astronomy. The gold medal of the Society was awarded Mr. Donald C. Morton, who graduated in June 1956, with first class honours in the Astronomy Division of the Mathematics and Physics Course. He is now a post-graduate student at Princeton University.

The 1956 Chant Medal has been awarded to Mr. Maurice Drolet, a member of the Council of the Quebec Centre. The award was for his achievements as an amateur astronomer.

E. J. A. KENNEDY, *National Secretary*

## REPORT OF THE LIBRARIAN

The new Library at 252 College Street is provided with attractive built-in bookshelves, a display rack for periodicals, and adequate enclosed storage space. The library has been furnished with a fine library table and chairs and the reading room with comfortable soft chairs.

During the year all the books in the library were reclassified and rearranged. A new storage system for unbound periodicals and observatory publications was introduced to make them easily accessible.

In 1956 about 200 books and periodicals were loaned by the library; this is an increase of nearly a factor of three over the number loaned in 1952. The increase can be attributed to the relocation of the library and to increased interest on the part of the members.

Seventeen new books were added to the library in 1956. Many of these were purchased through another donation by Mr. Carl Reinhardt. The library is at present receiving 44 periodicals from all parts of the world and publications from many observatories. Nearly all of these periodicals are received in exchange for the JOURNAL.

J. B. OKE, *Librarian.*

## AWARD OF THE SOCIETY'S GOLD MEDAL FOR 1956

*Left to right:* J. H. Horning, National Treasurer, Donald C. Morton, recipient of medal, and Dr. Helen S. Hogg, National Vice-president. (*Courtesy of* "The Toronto Daily Star".) September 16, 1956.

## AWARD OF THE SOCIETY'S CHANT MEDAL FOR 1956

Dr. C. S. Beals, Dominion Astronomer and a Past President of the Society, announced the award of the Chant Medal to Mr. Maurice Drolet of the Quebec Centre:

La Société Royale Astronomique du Canada décerne avec plaisir la Médaille Chant à Maurice Drolet, du Centre de Québec.

La Médaille Chant, en l'honneur de feu le Professeur C. A. Chant, est décernée à un astronome amateur qui a fait une contribution importante à la science de l'astronomie.

M. Drolet est technicien sénior au département d'électro-encéphalographie de l'Hôpital du Sacré-Coeur de la cité de Québec. Depuis quelques années, il a poursuivi activement l'étude de l'astronomie comme amateur. Il est membre du conseil du Centre de Québec de la Société Royale Astronomique du Canada. Une de ses contributions importantes à l'astronomie canadienne a été l'organisation d'une expédition à l'occasion de l'éclipse solaire du 30 juin 1954.

Il a activement aidé a répandre l'étude de l'astronomie dans la province de Québec et a participé à de nombreux programmes de radio et de télévision.

# REPORTS OF SECRETARIES OF CENTRES

## TORONTO CENTRE

Growth in membership continued during the year; total membership at the year-end was 521 (including 19 Life Members).

Eleven regular meetings were held, and Council met three times. Four "Summer Star Nights" were arranged on the University of Toronto campus, and the usual telescope display was set up at the Canadian National Exhibition, August 24 to September 8, with more than 5000 Exhibition visitors taking advantage of the offer to view the moon, planets and double stars. A new "extra-mural" activity was a series of six "Sky Gazing Parties" in co-operation with *The Toronto Daily Star* at which several telescopes were set up in various city parks during the summer months and at which astronomical films were shown continuously during the evening. Attendance was more than 1000 on two occasions. Another new activity was a display of telescope-making techniques presented by our Telescope Makers Group at the Do-It-Yourself Show held October 23–27. An eleventh annual edition of the Centre's "Sky Facts" leaflet was printed and distributed to visitors at all of these outdoor events, the cost being covered by an advertisement kindly supplied by *The Toronto Star*.

Both the Telescope Makers Group and the Observation and Study Group were very active during the year. Arrangements were made with the Society's National Council to use basement space in the new National Headquarters, and this room was cleaned, furnished and provided with an outside entrance at a cost of $500 which was charged against the Centre's Special Purpose Fund, an accumulation over the years of annual donations by the Canadian National Exhibition Association in return for our providing the telescope display. An additional $500 donation from the same fund was voted by the Council of the Centre as a gift to the National Society to furnish the Library and Reading Room at the new building.

Speakers and subjects at the regular meetings of the Centre were:

January 24—D. A. MacRae, Ph.D.: "The Giant Radio Telescope at Manchester;" William Wehlau, Ph.D.: "New Plans for the Hume Cronyn Observatory of the University of Western Ontario."
February 7—Rupert Wildt, Ph.D., Yale University: "Inside the Planets."
March 6—Joint meeting with Toronto and District Science Teachers Association. "Do-It-Yourself Astronomy" with demonstrations by the Telescope Makers and Observation and Study Groups.
March 20—J. L. Locke, Ph.D., Dominion Observatory, Ottawa: "Harnessing the Energy of the Sun."
April 3—J. P. Wild, Ph.D., C.S.I.R.O., Australia: "Radio Astronomy Down Under."
April 17—Dean B. McLaughlin, Ph.D., University of Michigan: "The Surface of Mars."
June 19, July 17, August 14, September 11—Campus "Star Nights."
October 16—Members' Night at the David Dunlap Observatory.
October 30—C. S. Beals, Ph.D., Ottawa: "A Search for Canadian Meteorite Craters."
November 13—Helen S. Hogg, Ph.D.: "My Year with the National Science Foundation."
November 27—Merle Walker, Ph.D., Cleveland: "The Mystery of Nova Herculis."
December 11—G. D. Scott, Ph.D.: "When It's Very Cold" (Low temperature demonstrations). Followed by the Annual Meeting of the Centre.

The Observation and Study Group held six formal meetings, as follows:

January 9—Raymond R. Broadfoot: "Astronomical Pictures."
March 23—Ross Lemire: "Photographic Aids for the Amateur Observer."
April 13—Kurt Frenkel: "Globular Clusters."
May 25—David J. Gerrie: "The Gyroscope."

November 23—David J. Gerrie: "Numbers."
December 14—G. A. Cooper: "Talk on The Observer's Handbook."

In addition to these formal meetings, the Lunar section and Planetary section held several meetings, and members met frequently for observing purposes.

The Telescope Makers Group held 12 formal meetings. Members of the Group were in large part responsible for the success of the Summer Star Nights, the Sky Gazing Parties and the C.N.E. display, and their demonstrations at the Do-It-Yourself Show were a centre of attraction although surrounded by numerous commercial exhibits. A number of members of the Group were also on hand each Saturday night at the David Dunlap Observatory and their telescopes, set up outside the main dome, provided views of interesting objects to augment those shown in the D.D.O. instruments. Several members have instruments well on the way, including one 10-inch and one 12-inch telescope and two special short-focus mirrors were made for the University of Toronto physics department.

A plan was inaugurated during the autumn session of having informal coffee parties at the Reading Room after regular meetings of the Centre, and these have proved very popular.

It is with deep regret we must record the deaths during the year of several active and long-time members. Among these were Dr. Clarence Augustus Chant, our Honorary President, and T. Harold Mason, the Centre's Treasurer from 1932 to 1952. Both were Life Members. Others who passed away include: C. Frank Publow, who had been Vice-President for several years; Dr. Fred Tomingas, a member of Council; G. Kenneth Stevenson, Dr. William T. Williams, and Hugh Robertson.

FREDERIC L. TROYER, *Secretary*

## OTTAWA CENTRE

Two meetings of the Council have been held to plan the public meetings and discuss other business of the Centre.

Six public lectures were held as follows:

January 26—W. R. Hossack, Ph.D.: "Artificial Satellites."
February 14—W. J. Medd: "Eclipse Observations at Radio Frequencies."
March 13—A. G. McNamara, Ph.D.: "The Aurora."
April 17—Observers' Group: "A Discussion on the Planet Mars."
November 13— V. Gaizauskas, Ph.D.: "The Sun-spot Cycle."
December 4—Annual Dinner Meeting; D. C. Rose, Ph.D.: "The International Geophysical Year."

There is a very active Observers' Group, numbering about 30, which meets the first Saturday evening of each month. A field trip to the Solar Noise Observatory in South Gloucester was enjoyed; five members took part in the public lecture on Mars; and on September 5 seven or eight members brought their telescopes to the Dominion Observatory to enable everyone to have a look at Mars through a variety of telescopes. A number of the members spent one night meteor observing, in co-operation with the N.R.C., during the Perseid Meteor shower.

LLOYD G. MILLER, *Secretary.*

## HAMILTON CENTRE

During the year 1956, eight regular meetings were held in the Physical Sciences Building, McMaster University, two field nights and three council meetings to discuss the business of the Centre.

January 5—W. J. Sled, B.A.: "Radio Astronomy;" J. H. Sled, Phm.B.: President's Address.
February 2—J. G. Craig, B.Sc.: "The Speed of Light;" L. G. Reeds, Ph.D.: "The Agricultural Geography of Southern Ontario."
March 10—W. J. McCallion, M.A.: "A Look at Outer Space;" Joint meeting with the Hamilton Association for the Advancement of Literature. Mills Memorial Library Theatre.
April 5—B. Wishart: "Amateur Lens Grinding;" G. G. Harrop, B.D., Ph.D.: "The Bible and Astronomy."
May 3—F. Schneider: "Amateur Observations;" R. F. Aldwinckle, M.A., D.Th.: "God and the Astronomers."
July 12 and 13—Field Nights on the McMaster University Campus.
October 4—W. J. McCallion, M.A.: "The Magellanic Clouds."
November 1—S. Buntain: "The Geophysical Year;" H. A. Wood, M.A.: "The Geography of Northern Haiti."
December 6—N. Green, B.A., L.Th.: "The Earth's Motions;" H. S. Armstrong, Ph.D.: "The Interior of the Earth."

GEORGE MURCHIE, *Secretary.*

## WINNIPEG CENTRE

January 19—V. G. Martens: "Solar Energy;" R. J. Lockhart: "Handbook Discussion;" Astronomical Quiz; Observation.
February 6—Winnipeg Centre Council Meeting.
February 13—R. M. Petrie: "Clocking the Stars;" Observation.
March 26—R. Evans: "Questar-Photographic Telescope."
April 5—P. M. Millman: "An Airborne Solar Eclipse Expedition."
July 16–20—"Summer School's Starry Skies" – A series of daily lectures and evening observations on the grounds of the campus of the University of Manitoba.
August 10–13—Perseid Meteor Shower Observations from Bird's Hill and Woodridge, Manitoba.
September 7, 8—Public Observation Nights, University Campus, Fort Garry: "The Planet Mars."
October 17—B. Pasicov: "Summer 1956 Impressions from the Dominion Observatory;" R. J. Lockhart: "An Introduction to Celestial Co-ordinates."
October 19 to 22— Orionid Meteor Shower Observations from St. Norbert, Manitoba.
November 16—W. J. Johnson: "Eclipses and Occultations;" R. J. Lockhart: "Tercentenary of Edmund Halley."
December 19—Annual Meeting; R. J. Lockhart: "Star of Bethlehem."

NORMA TWEEDIE, *Recorder.*

## VICTORIA CENTRE

The activities of the Victoria Centre during 1956 were confined mainly to the seven regular meetings, five summer lectures, and a fund-raising campaign as an adjunct to the Society's national appeal for funds for a new building.

Six regular meetings were held at Victoria College, to whom we wish to extend our appreciation for the facilities they have so kindly made available to us. The speakers and topics were:

January 11—F. A. Kaempffer: "Is Space Travel Feasible?"
February 8—D. H. Craven:"Navigation."
March 14—Norman G. Rogers: "Time and its Measurement."
April 11—Gordon Shaw: "The Red Planet."
October 10—P. E. Argyle: "The Artificial Satellite."
November 14—Walter H. Stilwell: "Time and its Measurement."
December 5—W. W. Morgan, Ph.D.: "Galactic Structure." Annual Meeting.

The following lectures were given at the twenty-fifth annual *Summer Evenings with the Stars* to an enrolment of forty-two, exclusive of members:

July 30—J. A. Pearce, Ph.D.: "The Starry Heavens."
August 6—Anne B. Underhill, Ph.D.: "Satellites and Stars."
August 13—Visit to the Dominion Astrophysical Observatory.
August 20—J. A. L. Muir: "Would You Like to Make Your Own Telescope?"
August 27—K. O. Wright Ph.D.: "Mars, the Red Planet."

During 1956 the Centre's membership increased from 80 to 86 and is now comprised of 1 Honorary Life Member, 7 Life Members, 67 Members and 11 Junior Members. There were 18 new members, 14 of whom attended the 1955 Summer Course, 8 resignations, 3 transferences to other centres and we regretfully report the death of one member.

D. H. ANDREWS, *Secretary-Treasurer.*

## MONTREAL CENTRE

During this session the Montreal Centre, finally achieved its long cherished ambition of establishing a well-equipped observatory of its own. This was due largely to the members themselves who subscribed liberally to the observatory fund and also donated many materials and much free labour. Among the many workers who devoted themselves so generously to the cause of the Centre and its observatory the name of Mr. Frank DeKinder ranks high. In recognition of his work Mr. DeKinder was awarded the Chant Medal of the Royal Astronomical Society of Canada, an award which met with the complete and unanimous approval of the Centre.

The new observatory has proved a great attraction, especially when the new 6½-inch refractor with clockwork operation was installed. During the year there was a total of over 1100 attendances at the Saturday night observation meetings. The lectures proved again a popular feature, as in previous years. One lecture has been specially designated as the Horsley Townsend Memorial Lecture, in order to commemorate the late Horsley Townsend who bequeathed us such a handsome legacy. The first Townsend Memorial lecture was delivered by Dr. Harlow Shapley whose subject was "The Clouds of Magellan, the Gateways to the Universe". This proved to be a great popular attraction, as did also a lecture by Dr. Arnold Spitz on "Artificial Satellites". The other lectures, including the usual introductory lectures for beginners in astronomy, were also all well attended.

Star Night has always been a popular feature of the Centre's activities but it was allowed to lapse during the establishment of the observatory. This year it was resumed again and on the night of September 12, the public was invited to view the stars through any one of 20 telescopes lined up in Westmount Park. The public responded with enthusiasm and although the sky was overcast more than 1000 people attended and many new members were made.

In conclusion we note with regret that Dr. Henry Hall, whose work over so many years has helped to build up the Montreal Centre, to its present state, is no longer a member of our council. His appointment to the principalship of Sir George Williams College leaves him no time to spare for us and the gain to the College means a loss to us.

CHARLES FOX, *Secretary.*

## LONDON CENTRE

There were seven regular meetings and one joint meeting of the London Centre in 1956. The regular meetings were held in the Hume Cronyn Memorial Observatory

of the University of Western Ontario. Observations were made with the ten-inch refractor when weather permitted. The meetings were:

January 20—Amelia and William Wehlau: "The Structure of Our Galaxy."
February 24—Charles Carmaichel: "The Optics of a Telescope."
March 16—W. Wehlau: "The Evolution of Stars."
April 13—J. P. Wild: "Radio Astronomy." A joint meeting with the local branch of the Canadian Association of Physicists.
April 18—D. B. McLaughlin: "Mars."
May 18—G. H. Reavely: "Meteorites."
June 15—W. G. Graham: "Cosmic Rays."
December 7—Inspection of the Research Equipment of the Hume Cronyn Memorial Observatory.

WILLIAM WEHLAU, *Secretary.*

## VANCOUVER CENTRE

There were seven regular meetings of the Centre in 1956, all in the Physics Building of the University of British Columbia. The attendance varied between 105 and 27 averaging about 45. The speakers were:

January 10—K. O. Wright, Ph.D.: "The Atmospheres of the Stars."
February 14—A. W. Mackenzie: "Absolute Magnitude, the Parsec and the Parallax."
March 13—R. W. Stewart, Ph.D.: "The Formation of Multiple Stars."
April 10—M. A. McGrath, who demonstrated his Projector for Planetarium; A. W. Mackenzie: "The Moon from the Other Side of the Equator."
October 8—E. M. Price: President's Address; A. M. Crooker, Ph.D.: "On Making Telescopes."
November 13—P. E. Argyle: "The Artificial Satellite of the I.G.Y."
December 11—Gordon Morgan: "The Constellations."

There were tests or demonstrations, or both, at four of the five meetings of the Telescope Section. The average attendance was about 20. Nearly a dozen mirrors are under construction and eight have been aluminized.

The Centre put out telescopes on the University Grounds on suitable evenings on Tuesdays during July and August. At the Pacific National Exhibition, the Centre set out telescopes on eight evenings out of eleven and had an exhibit at the Hobby Show. The general public showed interest; eighty persons enquired about the Society, with a view to joining.

The Annual Dinner was at the Faculty Club on December 11. The annual meeting was held in the Physics Building after the Dinner.

There were three meetings of the Council during the year. Twenty-nine new members joined during the year and there are now seventy-five on the roll.

The Centre is much indebted to the University and to Dr. Shrum for the use of the Physics Building.

R. J. CLARK, *Secretary*

## EDMONTON CENTRE

The regular meetings of the Edmonton Centre have been held in the Arts and Science Building of the University of Alberta, through the kindness of authorities. The total attendance varied from 28 to 47. There was a special meeting in February addressed by Dr. Petrie. The annual dinner meeting was in the Corona Hotel. Refreshments after each meeting provide occasion for a more informal exchange of opinion and information. News and observing reports were continued in "Stardust". A successful series of lectures was given three of four Saturdays during the summer by the members of the observers group. Congratulations.

The main papers of the past year were:

December 8—H. B. Collier: "Science in China."
January 12—G. D. Garland: "Our Own Planet."
February 9—Earl Milton: "Radio Astronomy."
February 23—R. M. Petrie: "Some Stellar Distances."
March 8—H. Grayson-Smith: "Life History of a Star."
April 12— L. E. Gads: "Constellation Quiz;" D. R. Crosby: "Our Set of Transparencies."
May 10—A. Stockwell: "Mars – A Closer Look."
October 11—Earl Milton: "Trip to Meanook;" Franklin Loehde: "Mars Observations."
November 8—M. B. Stewart: "The Formation of the Elements."

E. H. GOWAN, *Secretary.*

## CENTRE DE QUÉBEC

Une organisation, désignée sous le nom de "Corporation de l'Observatoire de Québec", s'est formée au sein de notre Centre et a obtenu ses lettres patentes, en septembre dernier. La Corporation est nantie de tous les pouvoirs légaux pour recueillir par souscriptions populaires les fonds nécessaires à la construction d'un observatoire astronomique, à Québec, pour construire et administrer le dit observatoire. Tel est l'événement dominant de l'année, à notre Centre. La responsabilité de mener à bien le projet d'observatoire incombera maintenant à la nouvelle organisation, et le Comité de l'Observatoire, dissous par le même occasion, lui a fait remise des sommes recueillies au cours des campagnes précédentes.

Deux réunions générales ont été tenues au cours de l'année:

Le 15 février—Alfred Dumont: "Analyse de la Campagne de Souscription 1955."
Le 12 mai—J. P. Richard: "Bulletins de Contrôle des Miroirs de Télescopes."

A l'observatoire temporaire de la société, des travaux de réfection au montant de 200 dollars ont été effectués pendant l'été. La coupole a été recouverte d'une tôle d'aluminium en remplacement de la toile peinte, qui donnait des signes de fatigue après quatorze années d'usage.

L'affluence des visiteurs a été considérable à l'observatoire, tout particulièrement à l'occasion de l'approche de Mars. Pour satisfaire la curiosité du public, il a fallu prolonger les heures de visites jusqu'au milieu de la nuit, en fin d'août plus particulièrement. Les visites scolaires, placées au début de la soirée, entre 7 et 8 heures, ont été suivies avec enthousiasme par les élèves, de même que par les professeurs. Chaque école a toute la semaine pour accepter notre invitation.

L'Almanach-Graphique, publié par l'Académie des Sciences du Maryland et imprimé à Québec, a été distribué à au delà de cinq mille personnes. Des articles sur l'astronomie populaire et le projet d'observatoire ont été publiés régulièrement dans les grands journaux de la ville.

PAUL-H. NADEAU, *Le Secrétaire.*

## WINDSOR CENTRE

During 1956 seven regular meetings and two executive meetings were held. The average attendance was 50.

January—Everett R. Phelps, Wayne University: "Storms and Tornados;" L. Huneault: "Current Events."
February—Freeman D. Miller, Ph.D., University of Michigan: "Comets, in Reference to Astronomical Objects;" Chas. A. Bell: "Current Events."
March—William Wehlau, Ph.D.: "Recent Developments at the Hume Cronyn Observatory;" D. C. Bawtenheimer: "Current Events."

April—Rev. A. J. Weiler, C.S.B., Assumption College: "A Preview of Geology." Two short films: "Our Changing Earth" and "The Formation of the Earth."
June—At the home of Mr. and Mrs. D. C. Bawtenheimer. Films. Telescopic observation.
October— Donaldson Craig, Detroit Astronomical Society: "Astronomy in General with Special Reference to the Planet Mars." Film on the explosion of an H-bomb in the Pacific. L. Huneault: "Current Events."
November—Annual Meeting.

PERCY C. HAWKES, *Secretary.*

## CENTRE FRANÇAIS DE MONTRÉAL

Le bureau de direction du Centre Français de Montréal a tenu 2 réunions à son siège social officiel, soit la bibliothèque de l'Ecole Polytechnique, afin de préparer le programme de 1956.

Les membres se sont réunis neuf fois au cours de l'année pour entendre les conférenciers suivants:

Le 30 janvier—Gaston Lebrun: "Divers aspects du Ciel."
Le 23 février—Harlow Shapley, Ph.D.: "The Clouds of Magellan, a Gateway to the Universe." Le Centre Français était invité par le Centre Anglais à entendre le Dr. Shapley.
Le 26 mars—Jean Naubert: "La construction de la machine à rayer les réseaux pour les spectroscopes."
Le 23 avril—Lucien Coallier: "Mission de l'Astronome Amateur."
Le 4 juin— P. E. Bélisle, M.D.— "La médecine et les voyages interplanétaires."
Le 24 septembre—Marcelle Gauvreau, Jean Asselin: "Mars."
Le 15 octobre—Deux films: "Explorons l'Univers" et "La Famille Solaire."
Le 12 novembre—F. Laforest: "Nouvelle Théorie de la Surface de Mars."
Le 10 décembre— Assemblée générale; élection du nouveau conseil. Eugène Pelletier: "L'Histoire de l'Astronomie."

GASTON LEBRUN, *rapporteur*

## HALIFAX CENTRE

With the exception of the first meeting, held in the Halifax Memorial Library, the meetings were held in the Planetarium of the Nova Scotia Museum of Natural Science, through the kindness of the Museum. The average attendance was 15 members. In January members attended a talk by Fr. Burke-Gaffney at St. Mary's University. The meetings were as follows:

March 27—Fr. M. W. Burke-Gaffney: "Interstellar Matter."
April 24—L. Carrigan: Demonstration of the Planetarium.
May 30—R. L. Baglow: "Astronomy in Defence."
June 26—W. Bridgeo: "The Chemistry of the Sun."
September 25—L. Carrigan: Demonstration of the Planetarium and a 6-inch telescope.

A telescope-making class has been organized under the leadership of Mr. R. L. Baglow.

G. STEWART, *Secretary*

# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA
## STATEMENT OF INCOME AND EXPENDITURES
## FOR YEAR ENDED DECEMBER 31, 1956

### GENERAL ACCOUNT

| | | |
|---|---|---|
| **INCOME** | | |
| Membership fees | $4,144.88 | |
| Grants from Government of Canada and Province of Ontario | 4,000.00 | |
| Donations and miscellaneous contributions | 469.60 | |
| Sale of publications | 3,814.63 | |
| Advertising revenue | 834.72 | |
| TOTAL INCOME | | $13,263.83 |
| **EXPENDITURES** | | |
| Printing of publications | $8,602.17 | |
| Office salaries | 2,890.00 | |
| Rebates to R.A.S.C. Centres in respect of 1955 fees | 583.00 | |
| Rent (prior to purchase of Society's building) | 273.62 | |
| Stationery, printing and supplies | 456.81 | |
| Postage and express | 572.62 | |
| General and office expenses (including medals and awards) | 446.28 | |
| Library expenses | 131.85 | |
| Telephone | 132.26 | |
| Bank charges and exchange | 100.23 | |
| Provision for doubtful accounts | 58.67 | |
| TOTAL EXPENDITURES | | 14,247.51 |
| OPERATING DEFICIT | | *$983.68* |

### BUILDING ACCOUNT

| | | | |
|---|---|---|---|
| RENTS RECEIVED | | $2,026.50 | |
| EXPENSES | | | |
| Taxes | $462.24 | | |
| Heat, light and water | 439.57 | | |
| Property maintenance and repairs | 468.14 | | |
| Mortgage interest | 781.25 | | |
| Insurance | 25.84 | | |
| | | 2,177.04 | |
| DEFICIT ON BUILDING ACCOUNT | | | *150.54* |
| TOTAL DEFICIT FOR YEAR | | | *$1,134.22* |

# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

## BALANCE SHEET - DECEMBER 31, 1956

### ASSETS

| | | | |
|---|---|---|---|
| **CURRENT** | | | |
| Bank deposits and cash on hand | | $9,648.09 | |
| Accounts receivable | $1,237.89 | | |
| Less: Allowance for doubtful accounts | 58.67 | 1,179.22 | |
| Unexpired insurance and prepaid expenses | | 54.45 | $10,881.76 |
| **FIXED** | | | |
| Land and building—252 College St. (at cost) | | $33,500.00 | |
| Furniture and equipment (at cost) | | 2,107.27 | |
| Library (Nominal value) | | 100.00 | 35,707.27 |
| | | | $46,589.03 |

### LIABILITIES

| | | |
|---|---|---|
| **CURRENT** | | |
| Outstanding cheques | $4,573.42 | |
| Accounts payable and accrued charges | 352.24 | $4,925.66 |
| **MORTGAGE PAYABLE** | | 13,000.00 |
| **DEFERRED INCOME** | | |
| Membership fees for 1957 and subsequent years | $1,187.70 | |
| Prepaid subscriptions to Journal and Handbook | 1,764.22 | |
| Advance grant from Government of Canada | 3,500.00 | 6,451.92 |
| **TOTAL LIABILITIES** | | $24,377.58 |

### EQUITIES

| | | |
|---|---|---|
| Surplus (as per attached statement) | $20,211.45 | |
| Life Membership Reserve | 2,000.00 | $22,211.45 |
| | | $46,589.03 |

## ANALYSIS OF SURPLUS ACCOUNT

| | | |
|---|---|---|
| Deficit in General Account—January 1, 1956 | | *$93.07* |
| Adjustment setting up equipment and library as assets on books | | 250.00 |
| Opening surplus as adjusted | | $156.93 |
| Add: Special reserves appropriated for purchase of property | $11,601.21 | |
| Less: Loss on sale of securities | 59.18 | 11,542.03 |
| Contributions to Building Fund received during 1956 | | 9,646.71 |
| | | $21,345.67 |
| Deduct: Deficit for year ended December 31, 1956 | | 1,134.22 |
| **NET SURPLUS—DECEMBER 31, 1956** | | $20,211.45 |

R. M. PETRIE, *National President* J. H. HORNING, *National Treasurer.*

## REPORTS OF TREASURERS OF CENTRES

| RECEIPTS | Toronto | Ottawa | Hamilton | Winnipeg | Victoria | Montreal* |
|---|---|---|---|---|---|---|
| Balance from 1955 | $935.83 | $121.56 | $81.26 | $71.03 | $230.51 | $25525.83 |
| Membership fees | 2185.50 | 415.00 | 280.00 | 177.00 | 260.00 | 738.00 |
| Donations for N.O.† | 282.00 | 17.00 | | | 153.00 | |
| Contributions to Centre | | 10.00 | 23.00 | | 1.00 | 189.83 |
| Rebates from N.O. re 1955 | 22.00 | 139.00 | 71.00 | 60.00 | 6.00 | 10.00 |
| Educational activities | | 5.24 | 29.90 | | 59.00 | |
| Annual dinner | | 154.00 | | | 118.00 | |
| Sale of HANDBOOKS, etc. | | 45.00 | | | 8.45 | |
| Bank interest | | 1.99 | 2.18 | | .51 | 6.63 |
| Income from investments | | | | | | 458.23 |
| Total | $3425.33 | $908.79 | $487.34 | $308.03 | $836.47 | $26928.52 |

| DISBURSEMENTS | | | | | | |
|---|---|---|---|---|---|---|
| Fees remitted to N.O. | $991.00 | $277.00 | $234.00 | $147.00 | $210.00 | $492.00 |
| Donations remitted to N.O. | 62.00 | 17.00 | | | 253.00 | |
| Meetings and lectures | 275.43 | 18.33 | 40.00 | 13.50 | 61.48 | 633.84 |
| Annual dinner | 87.75 | 133.75 | | | 118.41 | |
| HANDBOOKS | | 62.00 | | 3.00 | | |
| Equipment and supplies | | 36.29 | | | 33.57 | 52.51 |
| Office and admin. expenses | 136.52 | 24.86 | 64.03 | 22.84 | 93.90 | 169.51 |
| General expenses | 64.97 | | .25 | | 4.11 | |
| Transferred to spec. funds | | | | | | 24964.00‡ |
| Balance carried to 1957 | 1807.66 | 339.56 | 149.06 | 121.69 | 62.00 | 616.66 |
| Total | $3425.33 | $908.79 | $487.34 | $308.03 | $836.47 | $26928.52 |

### TORONTO CENTRE SPECIAL PURPOSE FUND

| RECEIPTS | | DISBURSEMENTS | |
|---|---|---|---|
| Balance from 1955 | $1421.72 | Contribution to N.O. towards furnishing the Library | $500.00 |
| Annual grant from C.N.E. | 200.00 | | |
| Bank interest | 52.62 | Building entrance and furnishing basement room, 252 College Street | 457.35 |
| | | Balance carried to 1956 | 716.99 |
| Totals | $1674.34 | | $1674.34 |

M. ALTMAN, *Treasurer.*

*See next page for special accounts and report from Quebec Centre.
†N.O.—National Office. ‡Purchase of securities $19964.00.

| RECEIPTS | London | Vancouver | Edmonton | Windsor | Montreal | Halifax |
|---|---|---|---|---|---|---|
| Balance from 1955 | $0.83 | $109.85 | $155.24 | $72.03 | $200.19 | $25.96 |
| Membership fees | 45.00 | 192.00 | 158.00 | 127.00 | 144.00 | 95.85 |
| Donations for N.O. | | | | 17.00 | | |
| Contributions to Centre | 15.00 | | | 30.00 | 54.00 | |
| Rebates from N.O. re 1955 | 25.00 | 55.00 | 47.00 | 55.00 | | |
| Sale of HANDBOOKS, etc. | | 10.50 | 1.00 | | | |
| Bank interest | | 1.50 | 5.02 | 2.22 | 2.19 | |
| Total | $85.83 | $368.85 | $366.26 | $303.25 | $400.38 | $121.81 |

| DISBURSEMENTS | | | | | | |
|---|---|---|---|---|---|---|
| Fees remitted to N.O. | $45.00 | $128.00 | $102.00 | $92.00 | $96.00 | $48.00 |
| Donations remitted to N.O. | | | | 17.00 | | |
| Meetings and lectures | 26.12 | 17.15 | 19.25 | 27.50 | 17.50 | 9.00 |
| HANDBOOKS | | 3.78 | 1.50 | | | |
| Equipment and supplies | | 2.10 | 13.16 | | 70.00 | 27.15 |
| Office and admin. expenses | | 12.15 | 14.95 | 30.13 | 15.08 | 16.72 |
| General expenses | 0.12 | | | | 24.00 | 20.00 |
| Balance carried to 1957 | 14.59 | 205.67 | 215.40 | 136.62 | 177.80 | .94 |
| Total | $85.83 | $368.85 | $366.26 | $303.25 | $400.38 | $121.81 |

## MONTREAL CENTRE OBSERVATORY FUND

| RECEIPTS | | DISBURSEMENTS | |
|---|---|---|---|
| Balance from 1955 | $289.72 | Purchase of telescope (bal.) | $820.00 |
| From General Account | 5000.00 | Installing telescope | 9.24 |
| Refund overpayment | 1.00 | Alterations to building, etc. | 1751.44 |
| Interest on bonds | 3.00 | Heating installation | 700.00 |
| Bank interest | 19.51 | Balance carried forward: bonds | 100.00 |
| Donation | 25.00 | Cash | 1957.55 |
| Totals | $5338.23 | | $5338.23 |

C. N. S. YARNELL, *Treasurer*

## CENTRE DE QUÉBEC

| RECETTES | | DÉBOURSÉS | |
|---|---|---|---|
| Solde 1955 | $74.13 | Cotisations | $171.00 |
| Remboursement de pret 1952 | 300.00 | Remboursement emprunt 1955 | 114.62 |
| Subvention provinciale | 400.00 | Observatoire | 636.41 |
| Cotisations | 312.04 | Administration | 267.31 |
| Emprunt | 209.88 | Don Tresoirier National | 25.00 |
| Divers | 3.26 | Solde 1956 | 84.97 |
| | $1299.31 | | $1299.31 |

PAUL-H. NADEAU, *Le Tresorier*

REVISED CONSTITUTION AND BY-LAWS OF

# The Royal Astronomical Society of Canada

ADOPTED BY THE ANNUAL MEETING, FEB. 8, 1957

## CONSTITUTION

### Article I. Name

The Society shall be called the Royal Astronomical Society of Canada.

### Article II. Headquarters

The Executive Headquarters of the Society shall be located in the City of Toronto.

### Article III. Objects of the Society

The objects of the Society shall be:

(*a*) To study astronomy, including astrophysics, geophysics and such cognate subjects as shall be approved by the Society; and to diffuse theoretical and practical information with respect to such subjects.

(*b*) To publish from time to time the results of the work of the Society; and

(*c*) To acquire and maintain a Library and other property which may be desired for carrying into effect the objects of the Society.

### Article IV. National Officers of the Society

The officers of the Society shall consist of an Honorary President, a President, a First Vice-President, a Second Vice-President, a Secretary, a Treasurer, a Librarian and a Recorder. These shall be referred to as the National Officers when it is necessary to distinguish them from the officers of Centres hereinafter referred to in Article VII.

### Article V. National Council, Executive Committee

The affairs and business of the Society shall be managed and controlled by a National Council which shall consist of the National Officers of the Society, the Editor (chosen according to By-law X), the two immediate Past Presidents, three elective members, the Presiding Officer of each Centre organized as hereinafter provided for in Article VII, and an additional representative from each Centre appointed by that Centre.

No member shall be eligible for election to any one of the offices of President, First Vice-President, Second Vice-President or as an elective member to the National Council at more than three consecutive annual meetings, nor shall a representative to the National Council be appointed by a Centre for more than three consecutive annual terms of office.

In order to carry on the routine business of the Society or to meet any emergency which may arise when the National Council is not in session, there shall be an Executive Committee consisting of the President (who may delegate some member of the National Council to act in his stead), the Secretary, the Treasurer and two other members of the National Council to be chosen at its first meeting of the year. Any action taken during an emergency shall be reported at the next meeting of the National Council and shall be specified in the notice calling such meeting. The quorum of the Executive Committee shall be three.

### Article VI. Election of National Council

The Officers named in Article IV and the three additional elective members of the Society who serve on the National Council shall be elected at the Annual Meeting of the Society.

An official ballot paper shall be mailed to each member of the Society one calendar month prior to the Annual Meeting. Each such ballot paper shall contain one or more names proposed by the National Council for each vacancy, as well as the names of any who may have been nominated by five members in good standing at least two weeks before the issue of the ballot papers; with blank spaces in which the voter may substitute other names; and, to be valid, the envelope containing the ballot must, when returned,

bear the signature of the voter and must be received by the Secretary before the time of closing the poll at the Annual Meeting.

In case of an equality of votes for any office the members present at the Annual Meeting shall choose between the two candidates having the highest number of votes.

Should an office for any reason become vacant or should any elected member of the National Council die or resign before the expiration of his term, the vacancy for the unexpired portion of the term shall be filled by vote of the National Council.

### Article VII. Centres of the Society

When at any place or within any area in Canada a sufficient number of members of the Society desire to organize a Centre of the Society for the purposes stated in Article III, and to hold meetings thereafter, the National Council, upon the request of the said members, may authorize the formation of such a Centre.

The governing body of each Centre shall adopt its own constitution and by-laws which shall be in conformity with those of the Royal Astronomical Society of Canada and shall be submitted to the National Council for its approval.

Meetings of the Centres shall be known as Meetings of the Royal Astronomical Society of Canada.

A Centre may cease to be recognized as such by the National Council if, after consultation with its officers and after a careful assessment of its position, the National Council judges that its continued recognition as a Centre has ceased to be in the best interests of the Society.

A Centre may own a library, an observatory, instruments or other property; and the Centre alone shall be responsible for its property.

### Article VIII. Amendments to Constitution and By-Laws

The Constitution of the Society may be amended at the Annual Meeting; and due notice of any proposed amendment must, after authorization by a majority of the National Council, be sent to every member of the Society at least one calendar month before the date of voting. Such amendment to be adopted must receive at least two-thirds of the votes cast (in person or by mail). The said vote shall be enclosed in an envelope bearing the signature of the voter and must be received by the Secretary before the counting of the votes at the Annual Meeting.

All amendments to the By-laws shall be subject to the same conditions as those governing changes in the Constitution, but they may be made not only at the Annual Meeting but at any time when found expedient.

## BY-LAWS

### I. Membership

The membership of the Society shall comprise three classes:

(1) Members, including annual members and life members,
(2) Student Members,
(3) Honorary Members.

Persons may be elected Members or Student Members as provided in By-law II (a) or (b). They shall be listed either as attached to the Centre of their choice, or as Unattached Members. Members making application in writing may be transferred by the National Council from one list to another.

Student Members shall be limited to full-time students at any educational institution, and it shall be the duty of the officer enrolling them or renewing their membership to ensure that they are such, either through personal knowledge or by a letter from the educational institution involved.

Honorary Members shall be selected in recognition of scientific attainments of the highest order. They shall be chosen as prescribed in By-law III. At no time shall there be more than fifteen Honorary Members. Provision for an Honorary President is made in Article IV of the Constitution. Honorary Members shall pay no fees and have no votes.

### II. Election of Members

(a) Election of Members and Student Members attached to Centres. Persons desirous of being proposed for membership shall be recommended by at least two

members of the Society of a Centre. The proposal and recommendation shall be read at a meeting of the Centre of which the candidate seeks membership in the Society, and the election may take place at that or any subsequent meeting thereof. To be elected, the candidate must receive at least two-thirds of the votes of the members present, whereupon he, or she, shall become a member of the Society and shall be attached to the Centre at which he, or she, has been elected.

(b) Election of Members and Student Members unattached to any Centre. Persons desirous of being proposed for membership in the Society without being attached to a Centre, shall be recommended by at least two members of the Society. The proposal and recommendation shall be read and election shall take place at any meeting of the National Council. To be elected the candidate must receive at least two-thirds of the votes of the members of the National Council present at the meeting thereof.

(c) Upon payment of fees, the Treasurer of the Centre in the case of members and the National Treasurer in the case of members unattached to any Centre shall supply the newly elected member with a copy of the Constitution and By-laws of the Society. The Treasurer of the Centre shall forward to the National Treasurer the name and address of each new member as soon as his fee is paid.

Every candidate elected to membership shall pay his fee in advance; if he is not elected his fee shall be refunded.

The National Council shall, upon a two-thirds vote of those present at a lawful meeting of the National Council, have power to remove from membership in the Society any member whenever in its opinion the best interests of the Society shall seem to require such removal.

### III. Election of Honorary Members

Honorary Membership may be conferred as a recognition of scientific attainments of the highest order. Nominations for Honorary Membership shall be made to the National Council by a standing committee consisting of the President (chairman) and the two immediate past Presidents at its meeting in the autumn to nominate members of the National Council for the following year. The reasons for bestowing the honour shall be given in writing by the chairman of the committee. Not more than two Honorary Members may be proposed during any calendar year except on request signed by not less than two-thirds of the members of the National Council. For election, a majority of the votes of the members of the National Council, present or voting by mail, must be favourable. No person shall be elected an Honorary Member without his previously-expressed acceptance of the proposed honour.

### IV. Fees

The annual fee of a Member shall be five dollars.

The annual fee of a Student Member shall be three dollars.

Fees of Members and Student Members attached to Centres shall be collected by the Treasurers of the Centres who shall remit to the National Treasurer two-thirds of all such fees, retaining one-third for the Centre.

The annual membership fee shall be payable between the first of October and the thirty-first of December in each year. Payment of such fee shall entitle the Member to membership for a year commencing on the first of October and shall entitle him to receive all publications issued for the ensuing calendar year. If the Member applies for election before the first of July the full fee shall be paid and he shall receive all publications issued subsequent to his application and also back numbers for that calendar year if applied for and if available; if the Member applies for election between the first of July and the first of October one-half of the annual fee shall be paid and the Member may receive upon request, if they are available, a copy of the Observer's Handbook for that year and such other publications as may be issued after the first of July in that year.

Any Member at any time, all sums then due being first paid, may make a single payment of seventy-five dollars and become a life member. The Society at an Annual Meeting, on recommendation of the National Council, may confer life membership on any Member in recognition of services rendered.

If a life member is attached to a Centre his payment for life membership shall be collected by the Treasurer of the Centre, and of this sum one-third shall be retained by the Centre and the balance forwarded to the National Treasurer.

### V. Meetings of National Council

The National Council shall meet at the Society's Executive Headquarters, on the call of the President. In his absence, or in case of his refusal to act, any three members of Council may issue, or cause to be issued, notices for an emergency meeting. The notices shall state clearly the reasons the councillors have for calling the meeting; and no other business shall be transacted at such meeting than that of which specific notice has been given.

None other than routine or necessary business may be transacted at a meeting of the National Council unless it shall have been explicitly listed in the agenda in the notice calling the meeting. Such notice shall be mailed from headquarters at least fourteen clear days before the date of the meeting. The quorum of Council shall be seven.

Any measure supported by twenty-five members of the Society in good standing which is presented in writing to the Secretary shall be placed on the agenda of the next meeting of the National Council.

The National Council shall meet within the three-months period preceding the Annual Meeting and again within the three-months period following it. In addition there shall be such other meetings as are deemed necessary for the proper conduct of the Society's affairs.

### VI. The President

It shall be the duty of the President to take the chair at the meetings of the National Society and of the National Council; and in his absence one of the Vice-Presidents or other authorized member shall act in his stead. The President shall not vote at any meeting of the Society or Council, except where a casting vote is necessary to decide a question, in which case he shall give such casting vote.

The President shall ex-officio be a member of every committee of the National Council, and may vote as such member unless he is in the chair, when he shall only exercise the right of giving if necessary a casting vote.

### VII. The Treasurer

It shall be the duty of the Treasurer to receive all monies due to the Society, to keep all books pertaining to his office, to make all payments, to prepare the cash and balance sheets and have them duly audited, and generally to act under the instructions of the National Council. He shall make no payment on behalf of the Society unless such payment is first authorized by the Council, or unless such payment is of a necessary or routine nature. He shall, on receipt, deposit to the credit of the Society, in some chartered bank approved by the Council, all monies which come into his possession as such Treasurer. He shall pay only by cheque, signed by himself and countersigned by another officer appointed by Council.

### VIII. The Secretary

It shall be the duty of the Secretary to conduct the official correspondence of the Society and to report such to the National Council at the first meeting thereafter; and to issue notices calling meetings of the National Society or of the National Council as required.

### IX. The Recorder

It shall be the duty of the Recorder to keep accurate minutes of the meetings of the National Society and of the National Council. As soon as possible after each meeting of the National Council he shall send to each of its members a full report of the minutes of such meeting. A record of the minutes of the National Council shall be kept at the Library of the Society.

### X. Editor and Editing Committee

The National Council shall appoint an Editing Committee of three or more members, one member of which, to be designated by Council, shall be the Editor. This Committee shall be responsible for editing the Journal and the Observer's Handbook and such other publications as may be authorized by the National Council.

### XI. The Librarian

Subject to regulations approved by the National Council, the Librarian shall have charge of and be responsible for the safe-keeping and proper condition of the books

and publications, maps, photographs, and like property of the Society. He shall report the names of publications, donations, etc., received. He shall also have charge of the Exchange List of the Society, and shall oversee the distribution of the Society's publications. The Librarian shall also have charge of any instruments or apparatus possessed by the Society. He shall see that the rules governing the issue and return of books are obeyed, and that any property of the Society which may be loaned shall be returned at the time agreed upon and that any injury to it shall be made good.

### XII. Board of Trustees

A Board of Trustees shall be appointed by the National Council, consisting of three members including the Treasurer (chairman), for the purpose of administering the special funds of the Society and the investment of such funds. This Board shall also have charge of any real property of the Society; and shall make a report of its transactions to the Annual Meeting of the Society.

### XIII. Property Committee

A Property Committee shall be appointed by the National Council consisting of four members including the Treasurer, the Chairman being designated by the Council, for the purpose of managing, under the direction of the Trustees, the real estate and property owned by the Society.

It shall be the duty of this Committee to arrange and collect rentals, to pay taxes and charges for services, and to be responsible for maintenance of the property; and the Committee shall make a report to the National Council.

### XIV. Executive Secretary

An Executive Secretary shall be employed by the National Society to carry on the routine business of the Society under direction of the Executive Committee.

### XV. Annual Meeting and Common Seal

The Annual Meeting of the Society shall be held not later than the 15th day in March in each year. At this meeting the Officers of the Society shall make reports of all their acts during the preceding calendar year.

The Society shall have a common seal approved by the National Council of the Society.

### XVI. Regulations Relating to Centres

The Secretary and the Treasurer of each Centre shall prepare reports on the work of the Centre for each calendar year. These reports, duly audited, shall be considered at a meeting of the Centre and after approval they shall be transmitted to the National Secretary in time to reach him before the first day of February.

It shall be the duty of the Treasurer of each Centre to report promptly to the Executive Secretary, on forms provided, the names of those Members and Student Members who have joined the Centre or renewed their membership therein, so that their names may be placed on the mailing list for publications. The portion of the fees referred to in Article IV of the Constitution as payable to the National Treasurer shall be remitted to him quarterly by the Treasurer of each Centre along with lists, on forms provided, of the Members and Student Members from whom these fees were received.

# THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

## OFFICERS FOR 1957

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*Honorary President*—The Honourable W. J. DUNLOP, Minister of Education for Ontario.
*President*—HELEN S. HOGG, PH.D., Toronto.
*First Vice-President*—ANDREW MCKELLAR, PH.D., Victoria.
*Second Vice-President*—P. M. MILLMAN, PH.D., Ottawa.
*National Secretary*—E. J. A. KENNEDY, 252 College Street, Toronto.
*National Treasurer*—J. H. HORNING, M.A., 252 College Street, Toronto.
*Recorder*—FREDERIC L. TROYER, Toronto.
*Librarian*—J. B. OKE, PH.D., Toronto.
*Council*—W. H. ADAMSON, London; D. C. BAWTENHEIMER, Windsor; Rev. M. W. BURKE-GAFFNEY, Halifax; J. A. BUTEAU, Montreal; ROBERT S. EVANS, Victoria; H. B. FOX, Hamilton; E. H. GOWAN, Edmonton; G. HARPER HALL, Montreal; Mrs. K. M. HEATON, Toronto; R. J. LOCKHART, Winnipeg; D. A. MACLULICH, Ottawa; G. M. SHRUM, Vancouver; OSCAR VILLENEUVE, Quebec.

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*Treasurer*—MORRIS A. ALTMAN, C.P.A.
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*Director of Telescope Makers Group*—JESSE KETCHUM, 7 Thirteenth St., Toronto 14.
*Director of Observation and Study Group*—RAYMOND R. BROADFOOT, 763 Mount Pleasant Rd., Toronto 7.
*Deceased

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*Rapporteur*—Gaston Lebrun
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*Directeur des Observations*—Jean Naubert
*Conseil*—J. A. Buteau; Hector Collette; DeLisle Garneau; Mlle Marcelle Gauvreau; J. R. Grignon; J. P. Laviolette; Fr Robert, f.e.c.; Adelard Rousseau; A. D. Tessier.

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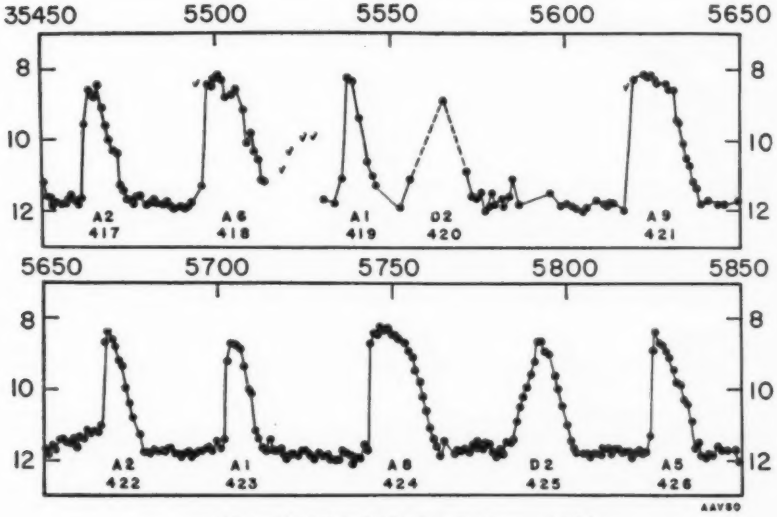
*Second Vice-President*—V. J. Pothier, j.p.
*Secretary*—Mrs. D. Naugler, 18 Ralph Devlin Drive, Halifax.
*Librarian*—W. A. Bridgeo, ph.d.
*Treasurer*—Dean Naugler
*Council*—R. L. Baglow; L. Carrigan; W. F. Dawson; B. J. Edwards; M. H. Goodwin; H. O'Shea.

# VARIABLE STAR NOTES

## American Association of Variable Star Observers

By MARGARET W. MAYALL, *Director*

213843 *SS Cygni.* The year 1956 was one of the most active years for SS Cygni for some time. As usual, it was well observed, and 871 observations were made by 44 members of the A.A.V.S.O. In addition, 170 observations by 7 members of the Scandinavian Astronomisk Selskab were made available to us in advance of their publication, through the kindness of Mr. Axel V. Nielsen. The combined work of the two societies was used to form the mean light curve shown in the figure, and to determine the data for the maxima as given in the table.




MEAN LIGHT CURVE OF SS CYGNI, 1956

The light curve is plotted from the daily means: individual points are means of from one to 15 observations each. The star was observed on 286 nights during the year, and it is fairly certain that no maximum was missed, although there is a gap of eight days with no observations, between maxima numbers 420 and 421. The narrow maximum, number 419, was confirmed by the S.A.S. observations. The only A.A.V.S.O. observation was one by Clinton Ford on the decreasing branch. The type, D2, of

number 420, is somewhat questionable because the real maximum may have been missed. The three points defining it are observations made by Donald Charles, Edward Oravec, and an S.A.S. observer.

Nine maxima were observed during the year. Number 425 is a well defined example of the rather rare type D curve, where the increasing and decreasing branches are nearly symmetrical. The other maxima, with the exception of the questionable number 420, are of type A, with a very sharp rise and slower decrease. Most of the minima are very irregular. Particularly noticeable is the slow rise from 11.8 to 11.2 between numbers 421 and 422.

The light curve and table are continuations of the yearly resumés published in these Notes. (See this JOURNAL, vol. 50, no. 4, p. 178.) Successive columns in the table are (1) number of the maximum; (2) type according to Leon Campbell's classification; (3) Julian Day for magnitude 10.0 on the increasing branch of the light curve; (4) number of days elapsed since the same point at the preceding maximum; (5) date of maximum; (6) number of days since preceding maximum; (7) Julian Day for magnitude 10.0 on the decreasing branch of the curve; (8) number of days since same point at preceding maximum; and (9) the mean magnitude at maximum.

OBSERVED MAXIMA OF SS CYGNI IN 1956

| Max. No. | Type | 10.0 I J.D. | Diff. | Max. J.D. | Diff. | 10.0 D J.D. | Diff. | Max. Mag. |
|---|---|---|---|---|---|---|---|---|
| 418 | A6 | 2435496 | 34 | 2435501 | 36 | 2435510 | 40 | 8.2 |
| 419 | A1 | 5536 | 40 | 5538 | 37 | 5542 | 32 | 8.3 |
| 420 | D2? | 5561? | 25 | 5565? | 27 | 5569? | 27 | 8.9? |
| 421 | A9 | 5618 | 57 | 5624 | 59 | 5634 | 65 | 8.2 |
| 422 | A2 | 5667 | 49 | 5668 | 44 | 5674 | 40 | 8.4 |
| 423 | A1 | 5702 | 35 | 5704 | 36 | 5709 | 25 | 8.7 |
| 424 | A8 | 5743 | 41 | 5748 | 44 | 5758 | 49 | 8.3 |
| 425 | D2 | 5788 | 45 | 5792 | 44 | 5797 | 39 | 8.7 |
| 426 | A5 | 5824 | 36 | 5826 | 34 | 5833 | 36 | 8.5 |

The mean interval between the maxima of SS Cygni during 1956 was much shorter than usual, only 40.1 days. The mean for all maxima since its discovery in 1896 is 51.6 days.

*Notes on Other U Geminorum-type Variables*

020356 *UV Persei.* No maximum has been observed by the A.A.V.S.O. since 1952. Mr. F. M. Holborn of the British Astronomical Association, writes that he has seen the star once each year since he started observing it in 1949. (*B.A.A. Journal*, vol. 67, no. 1, p. 42.)

060547 *SS Aurigae.* Four maxima were observed during 1956: 2435500, 10.5; 5553, 10.6; 5733(?), 10.9; and 5776, 10.8.

061115 *CZ Orionis.* Five maxima observed, as follows: 5502(?), 11.8; 5519(?), 12.0; 5550, 11.9; 5602(?), 12.4.

065209 *EQ Monocerotis.* This faint variable is observed by Thomas Cragg, who suspects maxima between 13½ and 14th magnitude on 5548, 5556, and 5560.

074922 *U Geminorum.* Two maxima were observed: number 361, 5563, 9.2; and number 363, 5776, 9.7, both of the narrow type. For a resumé of more than 100 years of observation of U Geminorum, see the previous issue of these Notes. (This JOURNAL,

vol. 51, no. 2.) A wide maximum should have been observed in February 1957, but at the time of writing these Notes, no observer has reported it. The interval will be at least 120 days, instead of the published mean value of 97 days.

080362 *SU Ursae Majoris.* Fourteen maxima were observed during the year. This is an excellent circumpolar variable for large instruments to follow. It varies from 11 to 14.5, with many maxima less than 10 days apart.

082953 *SW Ursae Majoris.* No maximum was observed during the year.

092421 *TU Leonis.* No observed maximum.

094512 *X Leonis.* The following maxima were observed during 1955 and 1956: 5116, 12.3; 5136, 12.4; 5152, 12.1; 5162, 12.5; 5181, 12.5; 5190, 12.5; 5404, 12.6; 5563, 12.3; 5571, 12.4; 5595, 11.6; 5626, 11.8.

180514 *UZ Serpentis.* Observed by Thomas Cragg. Maxima: 5612, 12.1; 5635, 13.0.

184137 *AY Lyrae.* A wide maximum was well observed on 5417, magnitude 12.2. Maxima observed during 1956 were: 5609, 12.4; 5623, 13.0; 5669, 13.2; 5721, 13.0; 5743, 13.1; and 4780, 12.8.

184826 *CY Lyrae.* Maxima observed by Cragg: 5635, 13.3; 5702, 12.9; 5731, 13.4; and 5758, 13.7.

195032 *EY Cygni.* Maximum observed by Gunnar Darsenius 5715, 12.4.

195109 *UU Aquilae.* Two maxima were observed in 1956, as follows: 5723, 11.0; and 5808, 11.9.

203501 *AE Aquarii.* Many rapid rises of about three-fourths of a magnitude were observed.

220912 *RU Pegasi.* This star is very erratic. Maxima were observed as follows: 5674, 10.7; and 5742, 10.5; both rather wide maxima. A rapid rise from 12.8 to 11.3 on 5715, and back to 12.8, lasted not more than two days in all. A very wide or double maximum was observed in December, when the star was brightest, 11.8 magnitude, at 5828 and again at 5839, with a drop of about one magnitude between the two peaks.

*Notes on Some Z Camelopardalis-type Variables*

005840 *RX Andromedae.* During the first three months of 1956, RX And varied regularly between 11.2 and 13.4, with a period of about 14 days. A few observations during June and early July were between the 13th and 14th magnitudes, but it became very irregular after that. It had a bright maximum at 10.5 on 5727. From 5795 to 5870 it did not rise above 12th magnitude.

020657 *TZ Persei.* This star does not have as much regularity as other stars of its class. Its mean period is listed as 17 days, but some of the maxima last that long, as for example the maximum near 5535, when it was brighter than 13.5 from 5530 to 5546. Again, it was brighter than 13.2 from 5771 to 5783.

054705 *CN Orionis.* More observations are needed of this star.

081473 *Z Camelopardalis.* The following maxima were observed during the first four months of 1956: 5490, 10.8; 5515, 10.4; 5542, 10.6; 5564, 11.0; and 5584, 11.0. Minima during this period were fairly constant at 13th magnitude. From 5600 to 5850, the variable was typical for its type and with smaller fluctuations remained near 12th magnitude.

195377 *AB Draconis.* This star is invisible in most telescopes except when it is near maximum. As a consequence, the observed curve consists of portions between 14.0 and 12.5, about 10 to 15 days apart. Observations with a large instrument are needed.

*Observations received during January and February* 1957: In January, 53 observers contributed 3,515 observations, and in February 44 sent 2,089, a total of 5,604 for the two months.

| Observer | January | | February | | Observer | January | | February | |
|---|---|---|---|---|---|---|---|---|---|
| | Var. | Ests. | Var. | Ests. | | Var. | Ests. | Var. | Ests. |
| Adams, R.M. | 84 | 174 | 45 | 105 | Kofoed, R. | 5 | 7 | 6 | 6 |
| Anderson, C. E. | 88 | 140 | 53 | 112 | Lacchini, G. B. | 40 | 62 | 39 | 141 |
| Aronowitz, C. | 27 | 37 | 25 | 25 | Lonak, E. M. | .. | .. | 1 | 1 |
| Ball, A. R. | 14 | 35 | .. | .. | Maran, S. P. | 2 | 2 | .. | .. |
| Barnhill, M. V. | 7 | 9 | .. | .. | McFarland, T. | 9 | 20 | .. | .. |
| Beidler, H. B. | .. | .. | 10 | 13 | Melville, E. C. | 6 | 9 | 19 | 24 |
| Breckinridge, J. | 1 | 1 | 3 | 6 | Montague, A. C. | 25 | 26 | 10 | 10 |
| Brinley, F. J. | 2 | 2 | 1 | 1 | Morgan, F. P. | 23 | 39 | 26 | 57 |
| Byrd, Wallace | 5 | 13 | .. | .. | Oravec, E. G. | 206 | 489 | 163 | 286 |
| Carlisle, J. H. | 1 | 6 | 1 | 2 | Osypowski, T. | 23 | 37 | .. | .. |
| Cragg, T. A. | 272 | 289 | .. | .. | Parker, P. O. | 74 | 100 | 25 | 41 |
| *Darsenius, G. O. | 9 | 16 | 18 | 86 | Peltier, L. C. | 19 | 38 | 18 | 34 |
| Diedrich, DeL. | 2 | 2 | .. | .. | Pilcher, F. | 3 | 3 | 9 | 9 |
| Diedrich, G. | 5 | 5 | 2 | 2 | Price, F. | 13 | 21 | 11 | 14 |
| Erpenstein, O. M. | 8 | 18 | 6 | 10 | Rizzo, P. V. | 21 | 30 | 9 | 9 |
| Fernald, C. F. | 90 | 122 | 76 | 99 | Robinson, L. J. | 7 | 7 | 23 | 40 |
| Ford, C. B. | 55 | 57 | 139 | 145 | Rosebrugh, D. W. | 14 | 110 | 14 | 102 |
| Fowler, C. E. | 5 | 8 | 3 | 9 | Royer, R. | 4 | 4 | 8 | 10 |
| Gemberling, R. H. | 1 | 1 | 3 | 4 | Segers, C. L. | .. | .. | 15 | 63 |
| Goldenblatt, P. P. | .. | .. | 8 | 8 | Sharpless, A. P. | 10 | 11 | .. | .. |
| Goodsell, J. G. | 1 | 1 | 3 | 3 | Shelby, J. | 10 | 10 | .. | .. |
| Halbach, E. A. | 35 | 52 | .. | .. | Skaritka, P. | .. | .. | 28 | 50 |
| Hartmann, F. | 139 | 143 | 83 | 83 | Solomon, L. | 43 | 47 | 16 | 21 |
| Hein, G. J. | 5 | 5 | .. | .. | Taboada, D. | 264 | 533 | .. | .. |
| Houston, M. S. | 4 | 7 | .. | .. | Thomas, M. A. | .. | .. | 2 | 4 |
| Houston, W. S. | 18 | 39 | 3 | 11 | Tsai, C. H. | 15 | 29 | 22 | 27 |
| Hutchings, N. | .. | .. | 8 | 17 | Turtle, J. P. | .. | .. | 2 | 2 |
| Isenberg, H. D. | 1 | 1 | 1 | 2 | Wend, R. E. | 6 | 8 | .. | . |
| Jacobsen, R. | 3 | 3 | 3 | 3 | Wyckoff, J. | 24 | 28 | .. | . |
| Kelly, F. J. | 11 | 11 | 10 | 10 | | | | | |
| Knowles, J. H. | 10 | 25 | .. | .. | | | | | |
| de Kock, R. P. | 131 | 623 | 110 | 382 | *Plus UV Cet 53[m] | | | | |

*A.A.V.S.O. Nova Search Report*, (from George Diedrich, Chairman). Observations of their respective Nova Search Areas were made by the following 9 members on 128 area-nights as indicated. The name is followed by the observations for December 1956 and then for January 1957: JAMES BRECKINRIDGE—2, 4; DELORNE DIEDRICH—3, 6; GEORGE DIEDRICH—6, 6; PAUL DIEDRICH—2, 1; ROBERT DUNN—3, 0; EARL MILTON—20, 0; LOUIS RICK—6, 0; W. H. SULLIVAN—38, 0; JAMES WESLING—13, 18.

A.A.V.S.O. Headquarters,
4 Brattle Street,
Cambridge 38, Mass.,
March 1957.

# NOTES FROM OBSERVATORIES

## Dominion Observatory, Ottawa

*Positional Astronomy*: Construction of a building to house the mirror transit is planned for this year. The transit will be completely exposed when in operation, by removal to the north and south of the two halves of the structure covering the mirror and telescope. Design of the micrometers for the 10-inch telescopes is on hand. The plane mirror was found to be one-fifth wave cylindrical and has been returned for investigation.

*Stellar Physics:* Drilling operations were carried out at the Holleford Crater. Three holes were drilled at varying distances from the centre and rock breccia and powdered rock were encountered at depths appropriate to an explosion crater. Preparations for observation of solar flares with the Lyot filter and visual observation of meteors during the I.G.Y. are essentially completed. An extremely fast lens (focal ratio f 0.71) is being tested as an objective for meteor spectrographs.

*Geomagnetism*: Instruments were tested and general arrangements completed for the operation of our observatories during the I.G.Y. A transistor version of the Observatory's portable magnetometer was designed and built. "Record of Observations at the Magnetic Observatories, Agincourt and Meanook, 1934–1935" has been printed. A paper on a statistical analysis of observations made by the three-component airborne magnetometer was published.

*Gravity*: A pendulum apparatus has been built, employing bronze quarter-metre pendulums. The pressure-tight case is thermostatically controlled and a portable quartz crystal oscillator is used as a time standard. An electronic system of recording is being constructed to improve on the present photographic method. Trials have shown the apparatus to be performing well, and a new gravity connection between the national bases at Ottawa and Washington is at present being made.

*Seismology*: A field party attempted a seismic survey of the Holleford Crater. Because of the high velocity of the surface rocks, penetration could not be obtained. Velocities of the country rocks were measured. Large shots recorded at radio-linked stations suggested an increased thickness of sediments in the crater, but no definite thickness could be determined. A device and a technique have been developed to permit the calibration of any electromagnetic seismograph very accurately and very quickly. All our electromagnetic seismographs will be calibrated by this device.

M.S.B.

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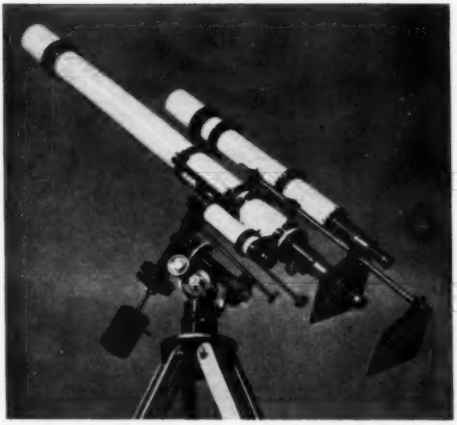

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